Electrical World

The consolidation of ELECTRICAL WORLD AND ENGINEER and AMERICAN ELECTRICIAN.
Published by McGraw Publishing Company, Inc.

Vol. 64 NEW YORK, SATURDAY, DECEMBER 19, 1914 No. 25

Public Telegraph and Telephone

The Postmaster-General steps into the limelight with another recommendation for the public ownership and operation of telephone and telegraph lines. His failure to have his plans carried out a year ago does not keep him from taking full advantage of the second opportunity offered by his annual report. This time he speaks to reiterate "the firm conviction of the department that telegraph and telephone service is inevitably monopolistic and when operated under private control does not render the maximum of public service at the minimum cost to the whole people." Why did he not consult the Department of Justice so as to be historically correct in his conviction? With much ado the Department of Justice worked out a very careful legal separation of telegraph and telephone service in the Western Union-American Telephone & Telegraph case. They are two services, not one. The contention of the Department of Justice is that they are not inevitably monopolistic. Does the Post-Office Department fail to appreciate the settlement of the long-standing telephone litigation, which President Wilson praised so earnestly? The conclusion forces itself upon us that the Postmaster-General still speaks for himself and for his already convinced department and not for the administration. "Maximum service at minimum cost" is a fine ideal, but "the whole people" do not use the telephone and telegraph. Greater efficiency is found in private operation than in public operation. Better service and lower operating costs come from private operation under adequate regulation than from public operation.

Safety Rules of Standards Bureau

The increasing scope and activities of the Bureau of Standards are set forth in the report of Secretary of Commerce Redfield, which is mentioned elsewhere in this issue. Regarding one result of these activities, Dr. Stratton, director of the bureau, has written to the *Electrical World* an article which is published on another page. There may be some difference of opinion as to whether or not the bureau is following the logical lines of its development in taking up a matter that affects so many varied interests as do the proposed rules of safety. Since, however, the work has gone so far as to receive an initial publication, it is of the highest importance that, as nearly as possible, it shall meet the requirements of the interests concerned. Dr. Stratton speaks of the publication of the bureau as preliminary and emphasizes the desire that criticisms shall be made. The most important suggestion that he offers bearing on the subject of a general consideration of the proposed rules by the various interests affected is that a conference be held later for an exchange of views. It is highly desirable that the request for study and criticism shall not pass unnoticed by the state commissions and engineering societies. Without effective co-operation between the interests directly involved in matters of this kind the best means necessary for the adoption of reasonable, satisfactory and workable rules cannot be determined with any degree of finality.

Public Lighting at Private Expense

Cities have so long imposed on the generosity of their citizens in the matter of public lighting that their officials overlook the fact that that which is paid for out of the public coffers is as nothing compared to that contributed by other sources. It is a reflection on any city when its merchants have to build "white ways" to light the chief thoroughfares properly, themselves shouldering the expense. It is a worse reflection when officials attempt to profit by this private lighting in reducing appropriations for public lighting. But when an official in a city like New York discovers that the metropolis of the Western Hemisphere, which minus its private lighting would be enshrouded in Cimmerian darkness, is over-lighted, we pause for breath. Crime and light have never had anything in common, and no one ever heard of a city that had too much light and too little crime. What all large cities lack is light, and we hope that some day city fathers will look upon appropriations for light as they do upon appropriations for public instruction—as necessary for public good and public defense.

The Three-Wire Generator

When first introduced as a substitution for the two-wire system, the three-wire system greatly reduced the amount of copper required to be installed in a given distribution network under any assigned set of conditions. It had the disadvantage, however, of requiring two generators to be used at the central station where one was used before. At a later date this objection was overcome either by using a relatively small balancer at the station, to the middle of which the neutral conductor was attached, or by employing a so-called three-wire generator, consisting usually of a full-voltage direct-current generator with an auto-transformer coil connected across taps in the armature winding 180 electrical deg. apart, the neutral conductor being then attached to the middle point of the auto-transformer. In an article which we print this week Prof. O. J.

Ferguson discusses in detail the actions which occur between armature and auto-transformer when the generator is at work. If the load is perfectly balanced, then of course the neutral conductor carries no current and a simple alternating current flows through the auto-transformer, just sufficient to excite it as the primary coil of a transformer without load. When, however, an unbalance occurs on the three-wire system, load current comes on the auto-transformer, which begins to take working alternating currents from the armature. The conditions are somewhat complex, but the author has succeeded in analyzing them in particular cases with the aid of oscillographic records.

The Electric Vehicle in Europe

From our viewpoint no great enterprise has yet been shown in Europe in exploiting the electrical vehicle, but there is an extremely intelligent interest in it which should count for much in the future. From the records brought forward by Mr. H. Beckmann in a recent issue of the *Elektrotechnische Zeitschrift*, there are not more than 4000 electric automobiles in the whole of Europe, the merest fraction of those which have been put into service in this country. Nevertheless, in some cities there has been real activity in developing the electric-vehicle business. The vehicle-charging stations in Berlin have a yearly output of about 10,000,000 kw-hr., and the larger German cities have already begun to show considerable activity in this particular line. Eastern Europe has been much less progressive and in fact has a very much less automobile traffic of any kind than has the West. The great variations in the price of gasoline on the Continent and the probability of still greater changes have encouraged the use of electric vehicles of late so that more rapid progress is being made than formerly. Of course, at the present moment, when Europe as a whole is at war, there will be lessened activity, but we are inclined to think that the electric vehicle will tend to come to the front since it is about the only kind of automobile which is not being used by the soldiers, and hence is unlikely to be permanently taken over by the governments. Even in the earlier stages of the war gasoline could be obtained only at an enhanced price, and now very little is to be had by anybody except for strictly military uses.

The effect of the automobile charging load on central-station service is found to be exceedingly good as respects the load-factor of the stations, and the aggregate amount of energy used has already shown large possibilities. The Berlin experience has developed some useful figures on the consumption of electrical energy in practice by vehicles of different sorts, running from about 0.2 kw-hr. per km for small passenger vehicles up to 1 kw-hr. per km for 5-ton electric trucks. These figures are, of course, rather exceptionally favorable, being derived from experience with good and level roads. The electric-vehicle business on the Continent and abroad generally is evidently very much in its infancy, yet the data thus placed at our disposal show that the central stations in the larger Continental cities are thoroughly alive to the needs of the situation, and if the war continues to prevent gasoline from being used for private motor vehicles a considerable extension of the electric service should be manifest. Abroad as here the secret of success is the provision of numerous charging stations where they can be conveniently reached so as to make the supply of motive power very simple even for the private owner of a small vehicle. The provision of charging sets which can be attached almost anywhere and left to do their work of replenishment will relieve the situation very much as regards passenger vehicles. It does not in the least obviate the necessity of convenient supply for the thousands of electric trucks which are in use here and are rapidly coming into use on the Continent. Electrical energy must be rendered as readily obtainable as gasoline before the electric vehicle will fairly come into its own.

Efficiency of the Gas-Filled Lamp

There is a notable tendency as time goes on toward the rating of the gas-filled tungsten-filament lamps at a lower and lower specific consumption. A consumption of 0.8 watt per candle seemed low in the beginning, but 0.6 or 0.5 is now the order of the day, with broad hints of 0.4 or even 0.3 in the near future. These lamps have been in use for too short a time to show what useful life corresponds to the various specific consumptions, and the most serious question of the immediate future is just what the relation between life and consumption will be. It is an old problem, this balancing of the specific consumption against the life. It was encountered first in the days of the old carbon lamp, again when the excellent metallized filament came into use, and once more for a brief period in the career of the tantalum lamp. There was much discussion nearly twenty years ago as to whether it would not be desirable to operate the carbon filament at a much higher efficiency than usual and allow the lamp to burn out in a correspondingly shorter time, and the same argument may very properly be made about the gas-filled lamp or any other new incandescent unit. The ultimate consumer naturally looks with cheer toward extremely high efficiency. The central station views the subject with some misgiving and the engineer wonders what the situation really is.

On the whole, there is some doubt as to the desirability of increasing the efficiency too much and too rapidly, not because high efficiency is not in principle good but because it may bring with it some rather undesirable qualities from a practical standpoint. For instance, the extreme brilliancy of the filament of an incandescent lamp of very low specific consumption involves the illuminating engineer in some considerable difficulties. The diffusing shades and globes entirely adequate for the ordinary tungsten lamp prove to be too small or too thin, or both, when used with the more brilliant and powerful gas-filled units. A word of caution should be given on this account since it is extremely easy with the new lamp to force a diffusing shade to a brilliancy far

too great for comfortable use. In other words, as the absolute and specific intensity of the source rises more and more an increasing amount of light must be sacrificed in keeping down the intrinsic brilliancy of the visible source. This situation is specially striking in indoors lighting, but it is also not without its effect in street illumination. An unscreened tungsten lamp of the older type can be used in the smaller sizes without unpleasant effect. A concentrated filament lamp of even the same candle-power possesses a brilliancy that many people find disagreeable and is altogether pleasanter when used with a frosted bulb or other means of diffusion. In short, the coming introduction of the gas-filled lamp will create an increased need for diffusing shades of one sort or another. The new lamp possesses many valuable qualities and has come to stay. The main problem is how best to utilize it.

Wireless in Time of War

The extensive use of wireless telegraphy over distances so long as to pass far beyond national boundaries and over the high seas raised some very serious international questions which have confronted the United States government during recent months. International law, in so far as it is a tangible and codified matter, has not had the opportunity yet to touch seriously on the rights of belligerents with respect to wireless service. It has been necessary to judge the new situation in the light of general principles and of such old precedents as may be fairly applicable. In case of war neutral countries have very wide options in adjusting their relations. Under the Hague conventions they are not even compelled to prevent the exploitation of actual contraband, much less to stop the use of ordinary means of communicating information which may be considered as conditional contraband. On the other hand, while the exportation of military supplies for the benefit of one or another belligerent is not in itself considered a *casus belli*, it is regarded as decidedly "bad form" in international society openly or covertly to help on belligerents, particularly if the neutral country in question is on friendly terms with both sides, as is certainly the case in the present instance. A proclamation of neutrality is generally in terms which make it evident that citizens of the neutral country are expected to keep clear of any acts which tend to destroy the balance of neutrality. President Wilson wisely added to the formal declaration a warning to the people of the United States to abstain not only from overt acts tending to favor one or another belligerent, but also from intemperate or abusive speech tending to disturb the amicable relations which, in this terrific crisis, the country has been trying to preserve with all the nations concerned.

It is the clear duty of any country righteously intending to be neutral to prevent its territory being used as the basis of warlike operations by any belligerent upon any pretext whatsoever. If, for example, a cruiser of one of the belligerents should chase a ship of another into a fortified harbor of the United States and endeavor to destroy her, the attempt would very probably and properly be met by gunfire from the forts. In other words, a neutral says openly to the belligerents: "Fight in your own territory or on the high seas if you must, but intrude your armed quarrel on my territory at your peril." It is solely on this general principle that the attitude of the United States toward wireless communications has been based. There is no objection to the use of wireless telegraphy except in so far as it may be for the deliberate purpose of directing belligerents in hostile acts.

An attitude of repression of belligerent wireless messages was very promptly taken by the United States and has been held consistently. The chief difficulty has been, not in determining a perfectly fair and definite policy, but in carrying it out so that it would not work hardship in reaching its end. As it happened, estopping the use of transatlantic wireless bore hard upon the embassy of one friendly nation which chanced to be cut off from the ordinary channels of communication. This embargo was promptly lifted as a proper act of courtesy far enough to permit cipher messages between the embassy and its government to be transmitted. Thus the main question regarding wireless communication seems to have been settled in a perfectly straightforward manner. Cables stand in a different category, for the reason that they cannot be used for the purpose of directing hostilities upon the high seas. Messages sent by them, even if bearing concealed information, must be repeated to the belligerent's fleet at its own risk.

Central-Station Development in Germany

The natural restrictions imposed in Europe by the unusual war conditions upon building and upon the real-estate situation in general are necessarily felt in electrical service. In spite of the most systematic efforts to relieve the business situation, activity in almost every line which concerns the electrical industries has fallen off, especially in those countries most directly and immediately affected by the war. It is peculiarly hard on the electrical contractor and therefore bears seriously upon the manufacturer of electrical supplies. Nevertheless, the electricity works in Germany seem to have risen to the occasion and to have set about carrying out wiring campaigns so arranged as to bear as lightly as possible on the consumer; and hence construction work is still going on and the central-station business is showing much less loss than one would naturally expect. Some of the large municipal plants—for example, that in Frankfort—are entering actively into the installation business and are accordingly acquiring loads in places previously untouched. The shortage in petroleum products due to their being now held as contraband is also beginning to have its effect so that there will be a stronger tendency toward the further use of electricity on account of the difficulty of obtaining gasoline and kerosene. Altogether the German central stations seem to be showing determination and resourcefulness.

The News of the Week

**Activities and Events in the Electrical Field—
Reports of Meetings—Commission Findings, Etc.**

Illuminating Engineering Society Activities

At a meeting of the council of the Illuminating Engineering Society, Dec. 10, 1914, an extensive report of the status of illuminating engineering education in the colleges of this country was received from the 1914 committee on education, of which Mr. Preston S. Millar was the chairman. The report included: (1) A summary showing the extent of instruction in laboratory work in illuminating engineering at thirty-nine colleges; (2) a complete curriculum for a four-year undergraduate course leading to an illuminating engineering degree; (3) a one-year undergraduate adjunct course; (4) a one-year post-graduate course; (5) a classified list of books in English pertaining to illuminating engineering.

The following resolution was received from the committee on nomenclature and standards, of which Dr. A. E. Kennelly is the chairman:

"Resolved, that it is the opinion of this committee: (a) That the output of all illuminants should be expressed in lumens; (b) that illuminants should be rated upon a lumen basis instead of a candle-power basis; (c) that the specific output of electric lamps should be stated in lumens per watt and the specific output of illuminants dependent upon combustion should be stated in lumens per British thermal unit per hour."

The exhibition booth committee (electric), of which Mr. Ward Harrison is the chairman, submitted a report outlining the conditions under which the society's series of booths, which were designed to present in an attractive way the fundamental principles of good lighting, may be obtained for display in showrooms of central-station companies, at conventions, expositions, etc.

Dr. E. B. Rosa was appointed chairman of the research committee, and Mr. G. H. Stickney chairman of the committee on the time and place for holding the 1915 convention.

The Drexel Institute, Philadelphia, was elected a sustaining member of the society.

Meeting of Empire State Association

The first of the midyear meetings of the Empire State Gas and Electric Association was held in the Hotel Ten Eyck, Albany, on Dec. 10 and 11.

Mr. J. C. DeLong, the president, called the session to order at 2 p. m. on Dec. 10. The chief subject for discussion was the handling of bill and service complaints. The opening remarks were made by Mr. C. G. M. Thomas, who outlined the practices of his company. Mr. Thomas took up such questions as testing of meters, the adjustment of bills on account of fast and defective meters and the method of notifying the customer, as well as a number of other closely related points. Some of the members outlined their methods and the general discussion consumed the entire afternoon session. At 7 o'clock the delegates dined together at the hotel. There was no evening session.

The meeting reconvened at 10 a. m. on Dec. 11, when a further discussion took place in reference to the complaint question. It had been announced in advance that one session should be open for the discussion of any subject the members cared to present. A number of interesting points were brought up in this open session, which lasted until 4 p. m.

The secretary, Mr. C. H. B. Chapin, was instructed to send a telegram to Mr. Thomas A. Edison expressing the regret and sympathy of the association in the loss and inconvenience occasioned to him by the fire in his plant. A suggestion was made to the executive committee that uniform practice in the adjustment of bills in the case of wrong meters was desirable and that a tentative scheme might be prepared and distributed among members for their criticism with beneficial results. One of the subjects which received considerable attention was that of consumers' deposits. A plan was proposed for the exchange of information in regard to customers who moved from one locality to another. The executive committee was also asked to take up this question.

Electrical Energy Exported from Canada

Of the hydro-electric energy generated along the international boundary in Canada more is exported to the United States than is used in Canada, according to a report issued by the Dominion government. The total production of electrical energy in 1913 by Canadian companies with transmission lines extending into the United States was 1,543,464,097 kw-hr., of which 772,597,049 kw-hr. was exported and 770,867,048 kw-hr. was used in Canada. The totals by companies are shown in the accompanying table.

KILOWATT-HOURS OF HYDRO-ELECTRIC ENERGY EXPORTED FROM CANADA OR USED IN CANADA

	Exported from Canada	Used in Canada
Canadian Niagara Power Company	400,214,908	11,420,020
Ontario Power Company	282,123,004	412,597,896
Electrical Development Company	42,154,000	191,885,670
Western Canada Power Company	23,213,891	39,339,239
Ontario & Minnesota Power Company	21,649,327	868,856

In addition, a large amount of hydro-electric energy is generated by Canadian companies in the vicinity of Montreal, Toronto, Quebec and Winnipeg. This is not included in these figures, as none of it is exported.

Opposition to Overhead Wiring Rules of Idaho Public Utility Commission

Lighting men of Idaho are very much exercised over the proposed rules to be adopted by the Public Utilities Commission to govern all overhead-line construction work by lighting, telephone, telegraph and railroad companies. The proposed rules were discussed at Boise, Idaho, on Dec. 4 and 5, at a meeting of the executive committee of the Idaho Power & Light Association, together with engineers of some of the larger companies, lawyers, and others especially interested. The lighting men insisted that the rules proposed by the telephone

companies were so drastic in many of their provisions that the lighting companies could not reach out into the rural communities owing to the excessive cost of construction for transmission and distribution lines. It was also felt that the effect of the new rules would be to drive the lighting companies from the streets and highways in many places and compel them to purchase private rights-of-way. Owing to the differences existing, the Public Utilities Commission postponed action on the matter until Jan. 11. The lighting men insist that if the rules proposed by the telephone and railway companies are adopted and made the law of the State by the Public Utilities Commission the lighting industry will be crippled in several important particulars. The companies realize that safety to human life is the first and most important consideration in all these matters, yet they feel that the rules for line construction can be made so liberal that the electric companies of the Northwest can be utilized in the development of the resources of the country.

To add greatly to the cost of constructing transmission lines and to establish rules that will make it practically impossible to build lines through many of the narrow canyons of the Northwest is, in the judgment of many lighting men, harmful to the mining industry. The lighting men expressed their willingness to cooperate with the commission and with all other interests to the end that the employees of the companies and the public shall have every possible protection. They object, however, to rules which will hamper them in their business, which will not add to the safety of the general public, and which will deprive rural communities of electric service that the companies are ready to give. In reaching out into sparsely settled districts it would be out of the question to employ the same character of construction that would be used in congested districts and cities. In order to make rural circuits feasible the cheapest construction consistent with safety must be followed. Recourse is often had to iron wire circuits strung on poles with twice the ordinary separation. The Northwest Electric Light & Power Association is also deeply concerned with the proposed rules, inasmuch as its activity extends over the States of Montana, Idaho, Washington and Oregon.

Boston Street-Lighting Contract Signed

The municipal authorities of Boston, Mass., and the Edison Electric Illuminating Company came to an agreement upon a ten-year street-lighting contract at a meeting of the City Council on Dec. 7. Mayor Curley promptly signed the contract, which covers about 4500 6.6-amp magnetite-arc lamps and a considerable number of incandescent lamps of various sizes, ranging from 40 cp to 200 cp, besides a few 1600-cp, 500-watt Thoran flaming-arc lamps used in the illumination of prominent squares.

To attain this price a temporary agreement has been reached on a rate of $87.53 per 6.6-amp, 500-watt direct-current magnetite-arc lamp per year, compared with $103.54 under the previous contract. According to the company's schedule, this rate corresponds to a fixed cost per lamp per year of $36 and to a running cost of 1.6 cents per lamp-hour, with a 10 per cent discount for the ten-year contract. The candle-powers specified refer to mean horizontal values in incandescent lamps and to mean lower hemispherical values in the case of arc lamps. Under the terms of the contract the parties in interest agree jointly to request the Massachusetts Gas and Electric Light Commission to determine whether the prices named (ranging from $10.80 per lamp per year plus 0.25 cent per lamp-hour running cost gross for 40-cp incandescent to $42 per lamp-year plus 3.2 cents per lamp-hour for 1600-cp flaming-arc lamps) are as a whole fair, taking into account length of term, discount and all other pertinent matters. If the board determines that the fair price for the entire service is less than the schedule names, the rates may be reduced by the commission and substituted for the tentative rates above named.

Lamps of any type may be substituted and resubstituted for lamps of any type if the city pays the total net expense to the company of making the changes (credit being allowed the city for the then market value of the displaced property) and if the comparative candle-power (mean lower hemispherical, with lamps equipped for use) is not substantially less than that of those displaced. The fixed-cost price of such substituted lamps is to be the same as that of the lamps displaced, and the running cost prices are to be determined by agreement between the Commissioner of Public Works and the company, subject to arbitration in case of disagreement. To meet possible improvements in incandescent lamps of the gas-filled or other type which may permit such lamps to be operated without increase of watts on circuits supplying energy to 500-watt magnetite-arc lamps, the company will, if maintenance cost is not increased, upon demand of the city and without charge for making the change, substitute such an incandescent lamp for any magnetite lamp at the price established by the Gas and Electric Light Commission. Other provisions are for an eight-hour day for employees on street-lighting work and the release of the city from liability for the unexpired term in case of purchase of the whole or a part of the company's plant. Sixty days' written notice is required to terminate the contract after the expiration of the ten-year period. The prices named in the contract are to date from July 1, 1914, which yields a refund to the city of $32,652 on the basis of the new rates.

N. E. L. A. Committee on House Wiring

Twenty persons, representing central stations, manufacturers, contractors, inspectors and other branches of the industry, attended the meeting of the N. E. L. A. committee on the wiring of existing buildings held at Cleveland, Ohio, on Dec. 10. Chairman R. S. Hale, of Boston, Mass., was delayed several hours by a train wreck, and as the opening of the session was belated, time was somewhat limited for discussion of the many topics presented for the committee's consideration. The important report of the sub-committee on the standardization of plugs and receptacles, which had been prepared at an earlier meeting in New York City, was accepted without discussion.

Unit Prices for Wiring

Although presented with a quantity of data and reports on unit prices for wiring, the committee felt that the figures obtainable were not in dependable form for comparison. Mr. A. J. Hixon and Mr. Hugo Eisenmenger were accordingly appointed to draw up specifications of buildings of representative types, and to secure estimates of the cost of wiring these in various localities under differing conditions of material and labor prices.

Instead of compiling a special handbook on house-wiring methods, the committee recommended the adoption by the N. E. L. A. of the Cushing manual, adding, if necessary, chapters especially suitable to the needs of the association.

The recommendation that the National Electrical Code be changed to make permissible the omission of the

neutral fuse on grounded three-wire systems was referred to the association's insurance expert, Mr. W. H. Blood, Jr.

"Bare Concentric Wire" for Single Circuits and Extensions

Mr. H. R. Sargent reported that the special committee appointed to consider the new "bare concentric wire" (described on page 1134 of the *Electrical World* of Dec. 12) has held several meetings and has prepared an appendix to the Code covering the use of this wire. It is proposed to permit the use of the concentric wire in small buildings requiring only a single (660-watt) circuit and for making extensions in fireproof structures. Mr. W. H. Blood, Jr., is chairman of the committee, and with him are associated Messrs. G. S. Lawler, Washington Devereaux, J. C. Forsyth, A. M. Paddon and Dana Pierce.

A proposal to designate plug and cartridge fuse sizes by different colors, and to have each fuse block marked, upon inspection, with a paster of the proper color, was referred to a sub-committee consisting of Messrs. Hale, G. B. Griffin and J. E. Latta. A proposed change in the Code to allow the use of several large lamps, as, for example, 500-watt units, without separate branch circuits for each, was referred to a committee composed of Messrs. H. R. Sargent and W. Slack.

The next meeting of the committee on house wiring will probably be held in Boston during February.

Meeting of Westinghouse Agent-Jobbers

The midwinter meeting of the Westinghouse agent-jobbers was held at French Lick Springs, Ind., Dec. 3, 4 and 5. Matters of mutual interest were discussed and the following officers elected: President, Mr. N. G. Harvey, Chicago, Ill.; vice-president, Mr. S. L. Nicholson, Pittsburgh, Pa.; secretary, Mr. Max McGraw, Sioux City, Ia.; assistant secretary, Mr. H. T. Pritchard, Pittsburgh, Pa., and treasurer, Mr. J. E. McClernon, New York.

The object of the association is to promote close relations between the manufacturer and the agent-jobbers, with a view to providing more efficient avenues for distribution of electric appliances, and to popularize the use of electrical apparatus and supplies, to the end that the purchase of such articles may be made easy and convenient for the ultimate user.

C., M. & St. P. Railway High-Voltage Direct-Current System

In connection with the electrification of the Puget Sound division of the Chicago, Milwaukee & St. Paul Railway, mentioned in the Nov. 21 issue of the *Electrical World*, arrangements have been made to obtain a continuous reliable supply of 3000-volt direct-current energy and distribute it to the trains with a minimum investment in substations and feeders. While contracts have been closed for equipment for only 113 miles of the system, it is reported that the railroad company may provide for electrical train operation from Harlowton, Mont., to the Pacific Coast, a distance of 850 miles, if the operating results of the 113-mile section prove as satisfactory as anticipated.

Two No. 4/0 trolley wires suspended side by side from the same catenary at 25 ft. above the rails will be employed to deliver energy to the pantographs on the electric locomotives. Twin conductors have been adopted to reduce the current density at the collector contacts. Although both trolley wires will be suspended from the same messenger, they will be attached thereto at alternate points by independent hangers. With this construction flashing will be practically eliminated even at speeds of 60 miles per hour, which will probably be attained by the passenger trains. The catenaries will be supported by brackets attached to wooden poles wherever track alignment will permit. On sharp curves and in yards the trolley wires will be attached to cross-span wires. Steel supports will be used in yards where the number of tracks to be spanned is too great for wooden-pole construction.

Perhaps the most interesting part of the locomotive equipment is the control which is arranged to allow regenerative electric braking on down grades. This is a valuable feature, for, in addition to providing the greatest safety in operation, it also returns a considerable amount of energy to the substations and transmission systems for other trains demanding energy. The regenerative braking will be sufficient to limit the speed of the train without applying air brakes except in emergencies or when stopping the train. As the method of electric braking which will be used does not require the pressure of brake-shoes on the rims of the driving wheels, considerable wear on the wheels and tracks will be eliminated. As electric locomotives require inspection only after a run of approximately 2000 miles, they can be employed on longer runs than steam locomotives, which have to be stopped periodically to take on water or coal, dump ashes, clean boilers or undergo petty roundhouse repairs.

It is declared that the locomotives, which will weigh approximately 260 tons, will be more powerful than any steam or electric locomotive yet built. The drawbar pull available for starting trains will be approximately 120,000 lb., assuming a coefficient of adhesion of 30 per cent. The locomotives for both freight and passenger service will be similar in all respects except that the passenger locomotives will be provided with a gear ratio permitting the operation of an 800-ton trailing train at approximately 60 miles per hour. The freight locomotives are designed to pull a trailing load of 2500 tons up a 1 per cent grade at 16 miles per hour.

Each locomotive will be equipped with eight main axles driven by their individual 1500-volt motors. Each motor has one-hour rating of 430 hp or a continuous rating of 375 hp. The motors are twin-geared to their respective driving axles by pinions mounted on each end of the armature shaft. Sparkless commutation is afforded by equipping the motors with commutating poles and the windings are cooled by forced ventilation.

The electrification of the Puget Sound division of the Chicago, Milwaukee & St. Paul Railway is under the direction of Mr. C. A. Goodnow, assistant to the president, in charge of construction, and the field work is under the supervision of Mr. R. Beeuwkes, electrical engineer for the railway company. All of the electrical equipment is being furnished by the General Electric Company, Schenectady, N. Y. The initial electrification of 113 miles between Three Forks and Deer Lodge will be ready for operation, it is expected, by Jan. 1, 1916, while the rest of the section from Harlowton to Avery will be in operation about Jan. 1, 1918.

Developments in Cleveland

At the meeting of the City Council on Dec. 14 the vote of a week previous, refusing the application of the Cleveland Electric Illuminating Company to lay steam-heating mains in the business section, was reconsidered and the application was granted.

The council appropriated $200,000 for the purpose of constructing a new lighting system in the business section of the city. It is probable that new standards will

be used and an attempt will be made to secure a more artistic display.

The Cleveland Electric Illuminating Company has notified the city of its desire to terminate its contract for furnishing energy to the new high-pressure pumping station, as the municipal plant has erected a substation adjoining the pumping plant. Director of Public Service Benesch has appealed to the company not to terminate its contract and remove the equipment. The municipal plant, he says, is not in position to furnish the needed energy.

Transportation Plans for N. E. L. A. Convention

A meeting of the transportation committee of the National Electric Light Association was held at the association headquarters in New York on Dec. 15 and 16. Plans for transportation to the convention to be held in San Francisco on June 7 to 11, 1915, were discussed. The following members were present: Messrs. George W. Elliott, chairman; J. C. McQuiston, A. H. Manwaring, H. N. Sibbald, E. C. Bennett, C. H. Hodskinson and G. A. Freeman. Mr. John A. Britton, vice-president and general manager of the Pacific Gas & Electric Company, met with the committee to discuss the plans.

Arrangements have been practically completed for four distinct tours for Eastern delegates to the convention. Three of these will make complete journeys from the East to the convention and return. The fourth tour will comprise only the going journey, leaving delegates free to make their own selection of return routes. The circular tours will go over southern and midtranscontinental lines because the points of scenic interest on the northern lines are not open until after June 15. A new feature is a plan to make scheduled stops at various hydroelectric plants and transmission lines at points throughout the country traversed. The first of the tours will leave the East as early as May 24.

N. E. L. A. Commercial Section

About a score of members and guests of the executive committee of the Commercial Section of the N. E. L. A. met in Boston on Dec. 14 to discuss the work of the section in the coming year. Chairman E. L. Callahan, of Chicago, presided. Through the courtesy of the Edison Electric Illuminating Company an electrically cooked luncheon was served at 1 p. m. in the large restaurant on the Service Building grounds and a tour of these structures was added to the interest of the day.

The budget for 1915, which was approved with reference to the executive committee of the association, provides for an even broader scope of activity than the section has hitherto undertaken. It was announced that the issue of 125,000 Christmas booklets, "Gifts That Please," had been oversold.

Mr. R. S. Hale, chairman of the N. E. L. A. committee on the wiring of existing buildings, outlined the work which is being done to standardize plugs and receptacles and to stimulate wiring. Mr. R. R. Young, chairman of the committee on merchandising and the recent development of energy-consuming devices, outlined the work under way in this field and stated that the reports bearing on this subject will be ready to submit to the midwinter meeting of the Commercial Section executive committee in New York. Mr. H. C. Cushing, editor of the "Cushing Handbook of Electric Wiring," touched upon the features of the forthcoming edition. The publication committee of the section has underwritten 1500 copies of the manual, which will be sold generally to members of the association.

Public Utilities Work of the Bureau of Standards

In the annual report of Secretary of Commerce Redfield, covering the year ended June 30, 1914, a section relates to the work of the Bureau of Standards. This section refers to the activities relating to public utilities.

During the year an appropriation was made by Congress to conduct work in connection with public utilities. With the rapid growth of public utility regulation by state and municipal commissions a great number of technical questions have arisen which involve standards of regulation and control. The success of public utility regulation depends upon the carefulness with which it is based upon ascertained measures and standards.

An ideal regulation would involve standards for many details of the service and include the more complex subjects of quality, efficiency, distribution, process and control. This is an extension of the idea of units and standards of measurement of the simpler forms. Practically all divisions of the bureau, the report says, have been at times called upon to meet the demands for information and advice on these subjects.

The bureau has also been requested by state and city governments and public service commissions to assist in research designed to secure more efficient regulation of particular utilities. It is gratifying that the national government has available the laboratory facilities for submitting to rigid laboratory experiment the various technical questions connected with this subject. The bureau during the year has continued its advanced work and field investigation of methods of electrolysis mitigation. The results have been very gratifying.

In connection with electric-light and power service, the principal factors to be prescribed are quality and reliability and the accuracy of meters that measure the current. These may be investigated by experiment and measurement, and the results will be of great value to the public, both the consumer and producer, by making the mutual understanding more definite, thus avoiding suspicion and inefficiency. The bureau serves in a co-operative and advisory capacity as to standards involved. In special cases the bureau experts are asked to visit and study local conditions. The extent to which the regulation of public utilities involves laboratory work, field measurements, and standards is striking, the report declares. For example, the measurement of candle-power involves the plan of testing, the unit of candle-power, the effect of atmospheric conditions, the bases of rating, humidity corrections and corrections for air pressure. All these are measured details affecting the measurement of candle-power.

In the public utilities work the bureau has secured the ready co-operation of engineers, inspectors and local government officials. The bureau thus has available and is accumulating data and experience. It is enabled to tabulate and study such data and draft model regulations which have passed the critical scrutiny of the bureau and the best experts in the country. This enables the utilities commissions to begin upon a technically correct basis. The bureau aims to be in the highest degree helpful to the public, the public utilities companies themselves and the public service commissions which regulate them.

The bureau assists the state legislatures when called upon in connection with the technical details of legislation affecting measurements. These include the units, standards, measuring instruments and methods of measurement of the various public utilities, such as electric light and power service, gas, water and similar utilities, as well as all questions affecting the inspection of trade weights and measures. The various interests concerned, including the public service corpora-

tions themselves, the report adds, have requested the bureau's co-operation in connection with the standardization of these utilities. The bureau is an unbiased institution, ready to serve all concerned, and in general its work is done and its decisions reached only after the fullest consultation with all interested and after consideration of all sides of the subject. In other words, the bureau aims to take up mainly such questions as may be settled by experiment or by direct measurement.

The need for standards of length, mass, capacity, heat, light and electricity is now generally appreciated. Continual care and laborious experimental work is often needed to maintain many of these standards. Specifications for electric energy covering both quality and quantity may often be made even more exact than for materials.

Work of Bureau of Standard on Safety Rules for Electrical Practice

BY S. W. STRATTON*

The attention of the Bureau of Standards was drawn several years ago to the need of a thorough investigation of the subject of life hazard in electrical practice. For many years the Underwriters' rules had been in use and had exerted a powerful influence toward securing better electrical construction and reducing the fire hazard, but not sufficient account was taken of the equally important life hazard in these rules. It was evident that the preparation of such rules in a form that would be at once adequate and satisfactory would be no easy task. It was thought, however, that the Bureau of Standards occupied a favorable position for such an undertaking, and the bureau therefore asked Congress two years ago for a special appropriation to enable the work to be done. The appropriation became available July 1, 1913, and the work was begun at once. A few weeks before this, at the request of the secretary of the National Electric Light Association, Dr. Rosa presented to that association a short account of the work we proposed to do, and I quote from his address the outline of the work as then given:

"The general plan to be followed will be the same as that followed in other similar investigations by the Bureau of Standards, namely, to secure the advice and co-operation of those who are best prepared to give valuable assistance and counsel, and then after gathering together a large amount of information and the experience of the managers and employees of electrical operating companies, the manufacturers of electrical apparatus and others, to prepare a comprehensive report on the subject. Following that, or as a part of such report, we shall expect to prepare a statement or a set of rules for the guidance of managers of operating and constructing companies which shall embody what is believed to be the best practice in electrical construction as regards the safeguarding of human life, and a second set of rules or instructions for the guidance of employees for their own protection. In formulating such rules, we shall expect to utilize the best experience and judgment in the electrical industry. It is also hoped to formulate rules in co-operation with state commissions and other representatives of the public in such form that they could be adopted by such commissions or by city councils, to insure, as far as possible, that electrical companies conform to the best practice with respect to the safeguarding of human life."

Dr. Rosa closed his address with these words:

"We shall take up the study in the spirit of investigators, appealing both to experiment and experience, and shall ask you for the results of your extended experience derived from the various lines of investigation.

"The Bureau of Standards will be very glad indeed to have the official co-operation of this association, as well as the assistance of its individual members, both in planning the work and in carrying it out."

In accordance with the plans as outlined at the N. E. L. A. convention, the investigation has been carried out under Dr. Rosa's direction during the past eighteen months. Mr. W. J. Canada, an electrical engineer who has had ten years' experience in work which has specially qualified him for this investigation, was first appointed, and later two other well-qualified and experienced engineers were appointed to assist in the work.

We began by studying what had been done on the subject to date both in Europe and in America. We collected all the books of rules that have been issued by the operating and manufacturing companies and all the official regulations that have been put into effect anywhere, so far as we could learn of them. We conferred with some of the state commissions, with committees of engineering societies, with the representatives of the National Association of Municipal Electricians, the International Brotherhood of Electrical Workers, the Workmen's Compensation Service Bureau, the National Fire Protection Association, the Underwriters' Laboratories, with manufacturers and with a large number of engineers and superintendents of light and power plants. We studied accident reports and gathered information as to the causes of accidents.

During the first twelve months of the investigation preliminary drafts of four parts of a code of safety rules were prepared, as follows:

(1) Stations; for generating and substations.

(2) Lines; for overhead and underground line construction.

(3) Utilization; apparatus and equipment employed in the utilization of electricity.

(4) Operation; operating rules for employers and employees, stations and lines.

The operation rules were issued in a preliminary edition as Circular 49 about four months ago and distributed quite widely for criticism and suggestions to be utilized in a revised edition. The bureau has received a great many very favorable comments on these rules as well as many valuable suggestions to be used in the second edition. It is intended to secure the criticism of the three sets of construction rules by a large number of experienced engineers and superintendents as well as workmen and inspectors. Much of this conference work has already been done, and valuable suggestions have been received.

In order that the rules may be made as satisfactory as possible, it is intended to ask the formal co-operation of a considerable number of state commissions and engineering societies as well as the Underwriters' Laboratories, the Workmen's Compensation Service Bureau, the municipalities and the workmen, and it is hoped to hold a conference in Washington to discuss the proposed safety code after it has been brought into such shape that it can be considered approximately satisfactory for a first edition.

These four sets of rules form a code of electrical safety rules which will supplement the Underwriters' rules, and together they will form a complete electrical code. It is proposed that the Bureau of Standards take the chief responsibility in formulating the code of safety rules and subsequently keeping them revised up to date, as the electrical committee of the National Fire Protection Association takes the chief responsibility in formulating and revising the rules for fire hazard. In both cases every important interest affected will be consulted, and suggestions for improvement will be welcome from any source.

*Director Bureau of Standards.

It is believed that the Bureau of Standards occupies a peculiarly favorable position to undertake the preparation of such a code. With an able and experienced staff of engineers who will devote their whole time to the work and who can personally keep in touch with the electrical industries all over the country by frequent visits to the manufacturing plants and operating stations, as well as by attending the meetings of engineering societies and their technical committees and conferring with operators, inspectors, workmen and the representatives of state commissions, it is believed that we shall obtain not only full information but also a broad and unbiased view, and that the rules will be better and more acceptable than if prepared by the state commissions acting separately or together, or by the casualty insurance interests, or by the companies, or by the workmen's organizations, or by all of them.

The advantage of a single electrical code prepared from the standpoint of the fire hazard has been abundantly demonstrated. The advantage of a single code of safety rules will be no less real. The Bureau of Standards hopes and expects that the engineering societies concerned will respond to our request for further cooperation as cordially as have most of the state commissions that have taken the matter up, the fire and casualty insurance interests, the manufacturers, the operating companies and the workmen's organizations.

Hearings on Water-Power Bill

Hearings before the public lands committee of the Senate in Washington on the Adamson water-power bill have continued. Testimony has been presented by Messrs. John A. Britton, vice-president Pacific Gas & Electric Company; W. A. Brackenridge, vice-president Southern California Edison Company; Franklin T. Griffith, president Portland (Ore.) Railway, Light & Power Company; George C. Ward, vice-president Pacific Light & Power Corporation, and others. The testimony of some of the witnesses is indicated in the abstracts published below.

Testimony of Mr. Brackenridge

Replying to a question as to whether state regulation in California has been satisfactory, Mr. Brackenridge said that in general he thought it had been so far as his company was concerned. The previous condition, under which rate-making within municipalities was controlled by city authorities, was entirely unsatisfactory. Where there is competition the consumer is the one who must pay in his rate for necessary duplication of property and service. The business of the company increases at the rate of 15 to 16 per cent per annum. The company has over three and one-half years in which to complete the new hydroelectric plant now under construction. It is expected that by the time this plant is completed the demands for power will have increased so that all of the output of the new station will be absorbed. The probability is that the company will have to increase its steam-power facilities also. With some of its most efficient machinery the company has been enabled to get as high as 285 kw-hr. to 290 kw-hr. per barrel of oil.

Mr. Brackenridge said that the company would not proceed with the construction of new plants under the conditions proposed by the bill under consideration. While present conditions are unsatisfactory, he would not give up an unsatisfactory situation for one that was still more unsatisfactory. There is no need of the provision in the bill which would limit the sale of energy to any one concern to 50 per cent of the output generated. That in itself is enough to deter the company from undertaking to operate under this bill. Mr. Brackenridge suggested that the bill provide for a period of not less than fifty years, although he would be satisfied with a term of fifty years if that was fixed definitely without a condition of recapture.

In the judgment of Mr. Brackenridge as an engineer and operator, if all the systems in California were connected physically and the companies were consolidated financially the whole situation would be very much improved and the consumer would be better served. Citing the experience of the Niagara Falls Power Company, which was justified in proceeding in 1890 with its great development because of the prospect of selling to several large industries without long transmission, the witness said that the condition is not dissimilar in California. The company expects, if it is allowed to develop large powers, to find some one industry to take the entire output from one of the stations. The provision in the bill providing for recapture should be amended so as to make it clear that all of the property belonging to the lessee, whether on or off of government land or in any way affected in the power development, shall be purchased. It should be possible to make contracts for ninety-nine years so as to permit the encouragement of great industries and large investment.

Testimony of Mr. Ward

Mr. Ward said that the term should be not less than fifty years, and after the expiration of this period the right should continue until terminated and until compensation has been given for the value of all the property, including transmission lines and contingent properties. Many plants would not have been constructed if there had not been a customer for more than 50 per cent of the energy in the beginning. The bill should provide for acquisition of the property at a fair value and not the depreciated value.

Testimony of Mr. Griffith

Mr. Griffith objected to the provision in the bill that no more than 50 per cent of the output should be sold to one customer. That purpose is based upon the theory that monopoly is evil. The old theory of modern regulation is to avoid duplication of investment and by artificial means through the regulatory body to create conditions that were formerly sought to be obtained by actual competition. No public service man in the country to-day who is abreast of the times will raise his voice in protest against regulation.

Mr. Griffith expressed the opinion that further legislation by Congress would be necessary to extend the powers of the Interstate Commerce Commission so as to include the regulation of rates for the transmission of electric energy. It is entirely conceivable that developments may be made where the only possible market at the outset is to sell to a distributing company. If for any reason the company cannot make enough to take care of operating costs and also of obsolescence, these expenses are proper charges against the public because the earnings on the investment are limited by regulation. In most instances, and certainly in the West in the Pacific Coast cities and states, no electric company has earned enough above a reasonable return upon its invested capital to cover the obsolescence and depreciation that has occurred if the company is twenty or twenty-five years old.

Mr. Griffith expressed the belief that it would be unwise on the part of Congress to invade the power of the state to regulate rates and service of electrical energy generated and used within the state. For the proper regulation of interstate companies engaged in the development of water-power there should be co-operation between federal and state governments.

LIGHTING OF THE HOME

"Art and Science in Home Lighting" Discussed by the New York Section of the Illuminating Engineering Society

At the meeting of the New York Section of the Illuminating Engineering Society held in New York City Dec. 10, Mr. George W. Cassidy presented a paper entitled "Art and Science in Home Lighting." It was pointed out that to illuminate a home properly the lighting must be considered from the esthetical, physiological, psychological and economical viewpoints. To combine the esthetic and scientific ideas properly the architect should co-operate with the illuminating engineer. As every person desires to have his home as beautiful as his means will afford, it is important that the lighting fixtures should be designed to harmonize with the decorations of the respective rooms. From an ocular hygienic standpoint it is important that lamps having high intrinsic brilliancy should be covered by some sort of diffusing medium, or a larger number of low-intensity lamps should be employed. While a lighting system may be ideal from the physiological standpoint it may have an undesirable effect on the occupant of the room. To apply the principles outlined in the foregoing, the author described the manner in which modern suburban or country homes costing from $5,000 to $15,000 should be illuminated.

Discussion

Among those taking part in the discussion were Messrs. A. L. Powell, Norman Macbeth, M. Luckiesh, H. Calvert, L. C. Porter, George Leland Hunter, George H. Stickney and Preston S. Millar.

Mr. Powell pointed out that where large quantities of light are required it is preferable to supply it from a number of sources rather than from a single unit. He questioned the superiority of amber-colored light over other tones, saying that it is advisable to tint fixtures to harmonize with the surrounding decorations.

Mr. Macbeth declared that daylight is far from satisfactory for bringing out the richness of different colors. In homes it is desirable to have soft, warm light rather than the cold, hard light of the noonday sun. He expressed himself as favoring dome fixtures for the dining-room, but declared that it is absurd to arrange the lamps where they can be seen by those seated at the table. A number of stereopticon views were cast on a screen to show the illuminating equipment in several homes. In one room shown candle-type fixtures were installed along the plate rail and mantelpiece to furnish illumination as well as to provide decoration.

Mr. Luckiesh said that there would be a big boom in fixture sales if the manufacturers would combine usefulness with appearance in the fixtures. As many people do not know when their homes are badly lighted, they should be educated to the use of proper illumination.

Mr. Porter suggested methods for converting old fixtures to the more sightly and efficient forms which do not cause eyestrain.

Mr. Hunter pointed out that it is practically useless to depend on any illuminant to produce a certain color effect in a room unless the trimmings and furnishings thereof carry out the same color scheme. The speaker declared that most fixtures are inartistically and improperly designed, and expressed himself as favoring softer light inside. Instead of employing fixtures to illuminate rooms, he advised installing a number of floor-plug receptacles to which portable lamps could be connected.

Mr. Stickney pointed out that if illuminating engineers would get together and compare opinions they could make many suggestions for improving the design of fixtures.

HIGH-VOLTAGE INSULATION

The Depreciation of Insulators and the Effect of Altitude on Spark-Over Voltage Are Discussed at A. I. E. E. Meeting in New York

Causes of insulator depreciation and the effect of altitude on spark-over voltages were the subjects discussed at a meeting of the American Institute of Electrical Engineers held Dec. 11 at New York City.

Effect of Altitude on Spark-Over Voltages

In a paper entitled "Effect of Altitude on Spark-over Voltages of Bushings, Leads and Insulators," by Mr. F. W. Peek, Jr., were given actual test data on the spark-over voltages of various designs of electrical equipment at different air densities and temperatures. Correction factors for different densities were given in order that the spark-over voltage of any piece of apparatus might be computed if its spark-over value at sea level were known. In most cases the correction factors are very nearly equal to the density, assuming it to be 1 at sea level. Cross-sections of the devices to which the curves refer were printed on the curve sheets. Curves were also given showing the relative barometer readings and air densities at different altitudes. Therefore, if it is desired to find the spark-over voltage of a certain type of insulator at a certain temperature and altitude, it is only necessary to refer to one chart to determine the air density relative to that at sea level, then to the data on an insulator of similar design for the correction factor, and finally to the curve sheet to determine the spark-over voltage. The starting point for corona may also be determined in a manner similar to that described for determining spark-over voltage.

Insulator Depreciation

In a paper entitled "Insulator Depreciation and Its Effect on Operation," by Mr. A. O. Austin, it was pointed out that insulator failures are not attributable so much to fatigue in the material as to depreciation caused by the absorption of water or by the cracking of the dielectric from high internal mechanical stresses set up by uneven temperatures or by the unequal expansions of cement, metal and porcelain. The shape of the insulator parts has a considerable effect on the maximum stresses which will occur. Sulphur fumes in the air appear to attack cement and increase the crystalline growth presumably of calcium sulphate, thereby causing expansion and excessive stresses. Cements may also be forced to expand by the formation of acids caused by static discharge.

In connection with insulator construction the author pointed out that the substitution of a sanded surface for grooves to hold the cement will eliminate high shearing stresses and will be found to furnish equal gripping strengths in every direction. Vibratory stresses, which are most severe in dead-end insulators, may cause a break-down of the dielectric structure. On one of the long-distance transmission systems in this country 1.4 per cent of the insulators out of the 2 per cent shown by a megger to be weak were defective because of lack of vitrification. Apparatus was illustrated which is more sensitive than the megger and therefore preferable for factory tests. Where insulators made up of six or more closely spaced, well-tested sections are employed it is declared that there is little danger of puncture from high-frequency surges.

A formula for operating hazard was also developed giving an idea of the relative economic importance of the number of sections in an insulator, the magnitude of the switching surge and the rate of depreciation as affecting the reliability of the system. A number of curves were shown, one set indicating the advantage of adding enough sections to produce reliability, another

set showing that the operating hazard increases very rapidly with the increase in the rate of depreciation, particularly if the insulating material is designed to withstand pressures only slightly above the surge voltage, and a third set showing how discharge points will improve the factor of safety of insulators having only a few sections but not one containing a long string of units. From these curves it was pointed out that it is more economical to install reactance or resistance in switching circuits than it is to increase the total insulation of the system. As depreciation is likely to reduce the total number of good units in a string, it is advisable to employ discharge points to allow the remaining good sections to flash over rather than puncture.

Discussion

Among those taking part in the combined discussion of the two papers were Messrs. H. L. Curtis, D. B. Rushmore, E. D. Eby, P. W. Sothman, Selby Haar, Paul M. Lincoln, Charles P. Steinmetz, E. E. F. Creighton, Farley Osgood and the authors of the papers.

Mr. Curtis showed by curves that the surface leakage over insulators is affected but little by temperature and voltage, but to a great extent by the atmospheric humidity. With hard rubber which has deteriorated from exposure to light the surface leakage may be multiplied by a factor as large as 10^{11}. Waxy materials, such as paraffin and beeswax, change very slightly.

Mr. Rushmore expressed the opinion that the depreciation of insulators will be understood only after a scientific study has been made of the cements and porcelains employed in their construction. He called attention to the need of determining the quantitative value of ground wires, as hundreds of thousands of dollars are spent every year to install them and still nobody knows of just how much value they are. The speaker expressed the opinion that surface leakage has to be taken into consideration in determining this value.

Mr. Eby pointed out that, except in very rare instances, the corrections are not worth considering except as an additional margin of safety. Going further the speaker called attention to the large difference between the correction factor and the density when only one unit of a string of insulators is considered. As the factors of safety usually employed in designing electrical equipment would prevent sparkover at sixty cycles even at the maximum elevation, it was suggested that the data compiled by Mr. Peek be corrected to apply to high-frequency disturbances.

Mr. Sothman said that laboratory tests on insulators show that they alone should not be studied to prevent break-down, as the condition of the atmosphere and the characteristics of the circuit affect the break-down value considerably. He advised using a higher factor of safety than is employed at present, to make insulators more immune to break-down than other parts of the transmission or generating system. The speaker called attention to the fact that in three or four years the percentage of failures due to insulator defects has dropped from 48 to 6 or 7, this being due to the improvement in porcelain. He was of the belief that if transmission engineers and porcelain manufacturers would exchange opinions and observations a substantial improvement in insulators could be made soon. Future development of insulators may be seriously handicapped, declared Mr. Sothman, if insulator specifications are adopted without carefully considering all of the phenomena which affect successful operation.

Dr. Steinmetz said the line should be the strongest part of a system as faults can be located and repaired more quickly in a generating station than on the transmission line. He pointed out that normal line voltage and frequency seldom break down insulators; therefore they should be tested with high-frequency and surge potentials. Attention was called to the fact that when rapid oscillations are caused by electrical resonance an indefinite voltage and a constant current are produced; therefore the break-down of an insulator tested thereby will depend on the power applied to the circuits. The speaker also called attention to the possible future use of some radiant energy to make porcelain transparent for the study of its internal strain by means of a polariscope and polarized light. By increasing the number of units in a string of insulators the reliability is increased considerably more than the margin of safety. Reliability of operation is also improved by eliminating surges, reducing depreciation of the insulators, and weeding out the faulty units. To locate defective insulators it would be preferable to have apparatus for testing them without de-energizing the transmission line.

Dr. Creighton referred to the limitations of the megger and the high-voltage direct-current method mentioned by Mr. Austin. No matter if insulator faults are due to under-fired porous porcelain or whether the units contain minute flaws, high-frequency power will develop the flaws and will rarely harm porcelain.

Mr. Osgood pointed out that an overhead ground wire is of great value in locating defective insulators; therefore, in considering its installation, the expense should not be assumed to be for protective purposes only.

Mr. Peek suggested that users of insulators inspect them carefully and demand of the manufacturers that not more than 2 per cent of the insulators fail as they come from the kilns. If a few per cent more than this amount should fail, the purchasers should be very suspicious of the insulators and perhaps condemn the whole pile. The speaker also pointed out that most insulator failures occur on low-voltage lines, rated between 20,000 volts and 40,000 volts, because the insulators are designed for the operating voltage, whereas they should withstand the lightning voltage which really causes the damage. He also spoke briefly of impulse tests on insulators, the voltage being measured fairly accurately by a sphere gap. The impulses referred to had a maximum value of about 1,000,000 volts and a duration of one one-millionth of a second. With each application the insulator "arcs over" much the same as if it were subjected to a lightning surge. The speaker called attention to the differences in the results which are obtained with high-frequency tests. While the difference between results is large it should not condemn any of these methods but should call attention to the fact that results should be differentiated.

Mr. Austin pointed out that an insulator which is dielectrically weak will have a larger factor of safety at high altitudes than at sea level, because flash-over will occur at a lower voltage. As the cost of line insulation varies as the square or cube of the cost of the station insulation, depending on the protective apparatus employed, it is advisable to use low factors of safety in the station to prevent damage to line equipment. Line surges may be damped to a considerable extent by inserting resistors in the circuits to prevent enormous rushes of current which occur during high-frequency disturbances. With enormous amounts of power back of a system in which the damping is small, it is advisable to remove an arcing ground from the system as soon as possible in order to prevent damage to any of the equipment. The effect of applying a high voltage to an insulator may not be noticed immediately but will probably start faults which are later developed by the operating voltage and mechanical stresses. If insulators are dielectrically weak, considerable protection against lightning will be afforded by employing a ground wire. Insulators are now made, however, which are practically lightning proof.

PUBLIC SERVICE COMMISSION NEWS

New York Commissions

Further testimony was taken by the New York Public Service Commission, Second District, on Dec. 9 and 10 in regard to the valuation of the property of the New York Telephone Company. Mr. Martin W. Littleton acted as special counsel for the commission in place of Daniel D. Murphy, who died recently. Among those who testified were Dr. William McClellan, consulting engineer for the commission; Mr. Milton B. Ignatius, Mr. Sergius B. Grace and Mr. Dean Langmuir.

Missouri Commission

The Missouri commission has ruled that the Pierce City Farmers' Mutual Telephone Company is not entitled to a rehearing of its petition to engage in business. The commission ruled that the Missouri & Kansas Telephone Company was giving satisfactory service at reasonable rates, and that there was not enough business to justify the entrance of another telephone company into that field. The commission suggested that in the very essence of things a local telephone exchange was a monopoly, and the greater the monopoly the better the service, the cheaper, the more convenient, with the least disturbance of streets, etc. Competition, the board said, was to be avoided in telephone service wherever possible.

Indiana Commission

The commission has taken under advisement the case in which Ingwald Moe and others at Gary, Ind., have petitioned to be allowed to construct a new lighting plant at Gary in competition with the Gary Heat, Light & Water Company, which now obtains its supply of electrical energy from the plant of the Illinois Steel Company.

The city of Indianapolis, through Corporation Counsel W. A. Pickens, has filed with the Public Service Commission a petition asking that the Central Union Telephone Company and the Indianapolis Telephone Company be required to connect their physical plants. According to one member of the commission, the only parties who may petition for physical connection of telephone plants are the utilities directly interested. Other commissioners, however, say that they believe that the question must be passed upon by the courts. The section of the utility law applying to physical connections specified "interested parties" as those who may start such an action.

District of Columbia Commission

An answer by the District Commissioners and the Public Utilities Commission in the suit instituted by the Potomac Electric Power Company and the Washington Railway & Electric Company to prevent the commission from enforcing corporate separation of the properties has been filed in the District Supreme Court by Corporation Counsel Syme and Assistant Corporation Counsel Stephens. The answer declares that under the public utilities law the commission is empowered to compel the Potomac Electric Power Company so to keep its accounts and records that they will show the cost of manufacture and distribution of electric energy and also losses in distribution. It declares that the exercise of this power is solely in the public interest. It declares that ownership by the Washington Railway & Electric Company of the entire stock of the Potomac Electric Power Company is contrary to law and has been used for the purpose of making the railway company the beneficiary of the property and franchises of the power company as though it had the legal title thereto.

Current News Notes

WASHINGTON JOVIANS MEET.—At the annual meeting of the Jovians of Washington, D. C., the following officers were elected: Statesman, Mr. J. C. McLoughlin; tribune, Mr. Thomas Fisher; secretary, Mr. W. B. Hadley; treasurer, Mr. C. O. Reed.

* * *

WASHINGTON WANTS ELECTRIC-VEHICLE MEETING.—The Washington branch of the Electric Vehicle Association, at its meeting on Dec. 10, appointed a committee for the purpose of trying to get the association to hold its next annual convention in Washington.

* * *

DIFFERENCES OVER CONTRACT IN FRANKFORT, KY.—Differences have arisen between the city of Frankfort and the Kentucky Public Service Company. The city demands immediate compliance with an alleged contract to furnish it with 2000-cp arc lights. Attorneys for the city claim to have discovered that neither the company nor its subsidiaries ever had franchises.

* * *

PIONEER SAFETY WORK.—Mr. J. E. Latta, of the Underwriters' Laboratories, Chicago, addressed the St. Louis League of Electrical Interests, Jovian Chapter, Dec. 15, on the topic of "Pioneer Safety Work." Mr. Latta referred to the national fire waste and the loss of life due to industrial accidents, and spoke in particular of the work done by the Chicago laboratories in making electric service safe.

* * *

JEWELER ADVERTISES HIS "WIRELESS" CONNECTION.—Mr. E. L. McDowell, an Arkansas City (Kan.) jeweler, has prepared a halftone reproduction of his store, above which a "wireless" aerial projects very prominently. Using this illustration on letterheads and in advertising, Mr. McDowell makes the claim of being the proprietor of the first jewelry store in the United States to receive time signals daily by wireless.

* * *

WATERPROOF BINDING COMPOUND.—Mr. J. E. Warner read a paper entitled "Flexible Compound and Its Uses" before the American Society of Engineers, Architects and Constructors at its regular monthly meeting in New York, Dec. 10. The compound which Mr. Warner described is an oil product and is used to bind pigments in paint and to render the paint moisture-proof. The speaker declared that the product can be applied to anything, from the finest silk to structural iron, and can also be used as an insulating compound.

* * *

STATISTICS IN BUSINESS.—Mr. N. C. Kingsbury, vice-president of the American Telephone & Telegraph Company, made an address on "The Special Service of Statistics to Business" at a dinner of the American Statistical Association held at the Yale Club, New York City, on Dec. 11. Other speakers were Messrs. Henry Bruère, chamberlain of the city of New York, on "The Potential Value of Statistics in Shaping Rational Public Opinion"; Mr. Carl M. Hansen, secretary of the Workmen's Compensation Bureau Service, on "The Need for Standardization in Accident Statistics"; Mr. Osmond Phillips, editor of the *New York Times Annalist*, on "Statistics for Public Consumption," and Mr. F. H. Dixon, chief statistician of the Bureau of Railway Economics, on "Statistics of Railroads." To further the development of statistics as a factor in the settlement of current business problems a special committee was appointed. This committee will report at the annual meeting of the association to be held at Princeton, N. J., on Dec. 28 to 31.

Hydroelectric Development on Bishop Creek, Cal.—X

Conclusion of the description of the Southern Sierras transmission system—The steam plant at San Bernardino—Typical outdoor substations—Imperial Valley line. By C. O. Poole

OWING to the long distance from the hydroelectric plants to points of delivery in southern California, it was early seen that an auxiliary steam plant would have to be erected near the lower end of the system to steady the load and insure against shutdowns. San Bernardino was chosen as a good location and accordingly became the terminus for the tower line from the Bishop Creek plants. Enough property in the southwest of the town inside the city limits was secured for the erection of the steam plant with room to make future increases should these become necessary.

From a study of the various prime movers it was decided to use a steam turbine, as the all-day economy by so doing promised to be higher than could be obtained otherwise. Preliminary designs and specifications were drawn up in 1911, and bidders were requested to supply designs and specifications suitable to the apparatus they proposed supplying, with guarantees as to the economy. Messrs. Charles C. Moore & Company, of San Francisco, obtained the contract, which included a 4500-kw Allis-Chalmers steam turbine directly connected to a 5000-kw generator wound for 6600 volts and operating at 1800 r.p.m. under a steam pressure of 180 lb. per square inch at the throttle, four 500-hp Stirling water-tube boilers, and Wheeler surface condensers. All auxiliaries, piping and oil-burning apparatus, a 2500-barrel oil tank, a pump house and a cooling tower were also included in the contract.

Early in 1912, on account of the rapidly increasing load, it was decided to double the maximum output of the plant by the addition of a 5000-kw General Electric steam turbine directly connected to a 5000-kw generator, three 500-hp Stirling water-tube boilers, making a total of seven, another cooling tower and a duplicate set of auxiliary apparatus. The building is of concrete steel with concrete steel roof, supported by 20-in. steel I-beams in place of the usual steel trusses. Figs. 77 and 78 show interior views and Fig. 76 an exterior view of the station. The boiler fronts toward the turbines, no partition wall being built between the boiler and turbine rooms. Thus the engineer on watch has the entire floor at all times under his supervision. Water for condensing is obtained from a deep well and after being pumped through the condensers is dropped through the cooling towers.

The matter of cooling the water has been a very difficult problem as during the hot weather the temperatures frequently rise for days to 100 deg. Fahr. and over. Some changes are now being made in the towers that will when completed more than double their rating. The value of the steam plant has been demonstrated on several occasions when through accidental or intentional cutting off of the hydro plants the regularity of the service has been maintained.

Substations

Each of the sectionalizing stations of the tower line is made a substation as well as a switching station.

Four three-pole Bowie switches on 45-ft. towers are placed in each circuit for the purpose of sectionalizing,

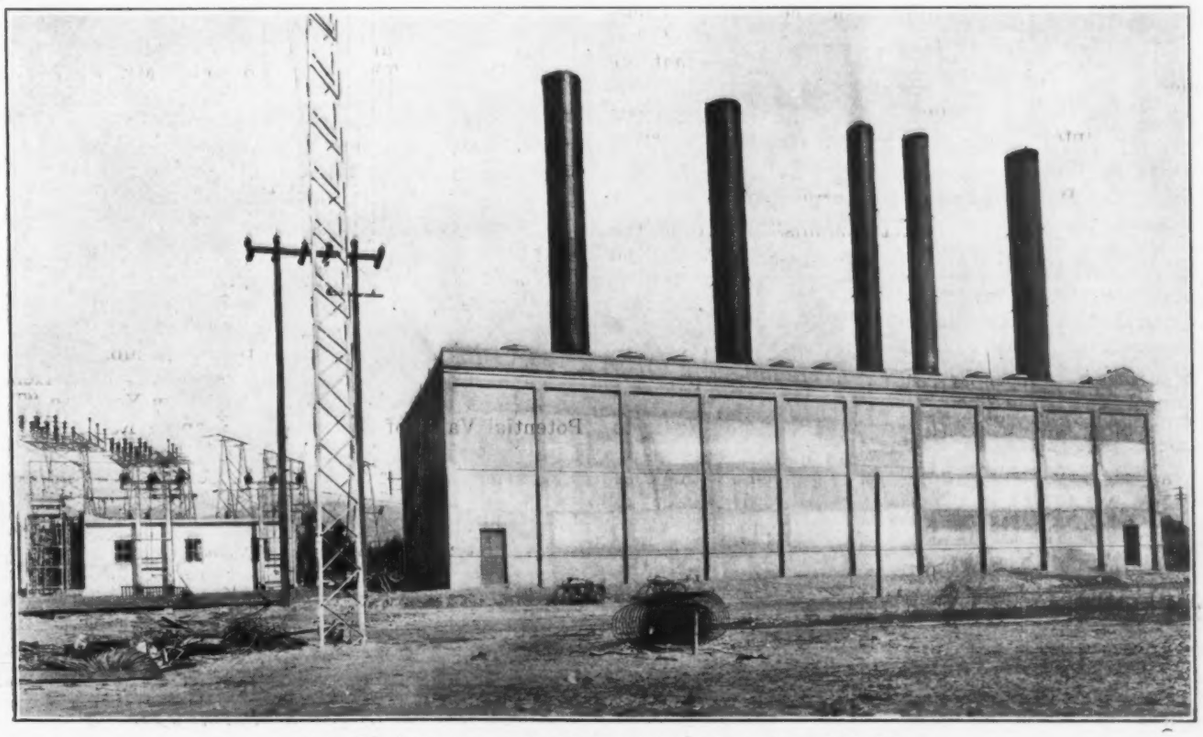


FIG. 76—EXTERIOR OF SAN BERNARDINO STEAM STATION

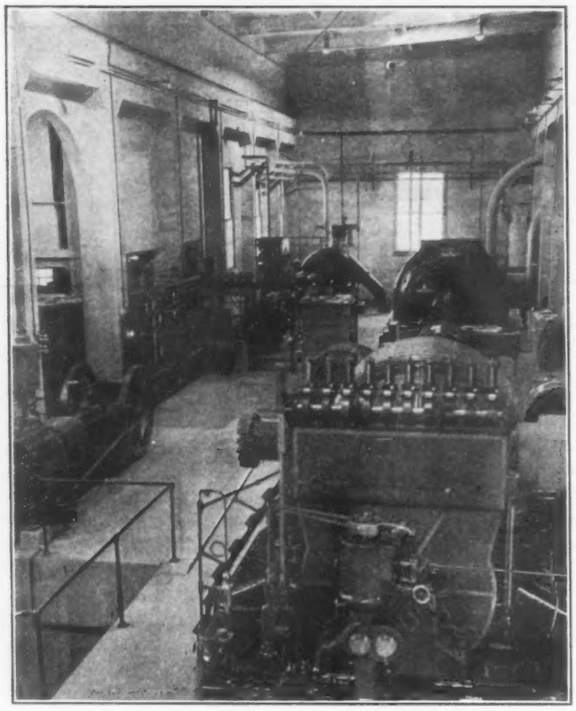


FIG. 77—TURBINE ROOM IN SAN BERNARDINO STATION

and a paralleling station bus with single-pole disconnecting switches at either end is erected at right angles to the lines and connected to them by vertical jumpers. This cross-bus is divided into two sections by disconnecting switches at the center of the switching plant. The disconnecting switches used in these installations are of special design and are a development of the company. They are mounted on a structure composed of several A-frames supported by diagonal bracing and consist of an angle-iron trussed blade supported at the hinged end by horizontal strings of suspension insulators and a set of jaws supported in a similar manner at a distance of 5 ft. above the lower strings. One of these switches is shown in Fig. 82. By the use of the standard line insulators the cost of the switch has been kept low, and the fact that the insulators are from tower-line material stock makes the replacement of a broken unit very simple and insures repair parts being always on hand. At one end of the station bus is the bank of lowering transformers, and at the other end a set of electrolytic arresters is installed. Each station is strictly of the outdoor type, with all switches and buses supported by structures of galvanized steel.

Three 500-kva water-cooled transformers are installed at these stations. These transformers are of Allis-Chalmers make and are wound for 87,000/36,000 volts, with a 55,000-volt tap on the high-tension winding and small percentage-reducing taps on both high-tension and low-tension windings. Distribution from the stations is at 33,000 volts, each of the distributing lines being protected by an automatic oil circuit-breaker at the station.

The transformers are mounted on concrete piers, and at right angles to the greater dimension of the piers is a transfer track upon which is a large truck. By the use of smaller trucks under each transformer it is an easy matter to move a transformer from its location if repairs are necessary. At one end of the transfer track a lifting rig is erected over a concrete-lined pit that, with dimensions of 9 ft. by 9 ft. by 16 ft., will accommodate the case of the transformer. The transformer is lowered into the pit by means of a hand-operated winch fastened to one of the legs of the gallows frame structure over the pit.

At the Inyokern station a building is erected above the hoisting arrangement large enough to serve also as a warehouse shop, garage and switchboard room.

Figs. 79, 80 and 81 show typical outdoor stations, these being the Lone Pine, Inyokern and Randsburg plants.

San Bernardino Substation

The San Bernardino substation, situated at the southern extremity of the tower line, is in most respects similar to the intermediate substations. The two lines terminate on 140,000-volt Bowie switches, mounted on extra heavy dead-end towers, tying in through them to a station bus. To this bus are connected the station transformers and lightning arresters. Three 4000-kva transformers of Allis-Chalmers make are installed at this station, and provision is made for three more of the same rating. The transformers now installed have three distinct windings—that is, a high-tension winding for 87,000 volts with a 55,000-volt tap, an intermediate winding for 36,000 volts with smaller taps, and a low-tension winding for 6600 volts, the latter be-

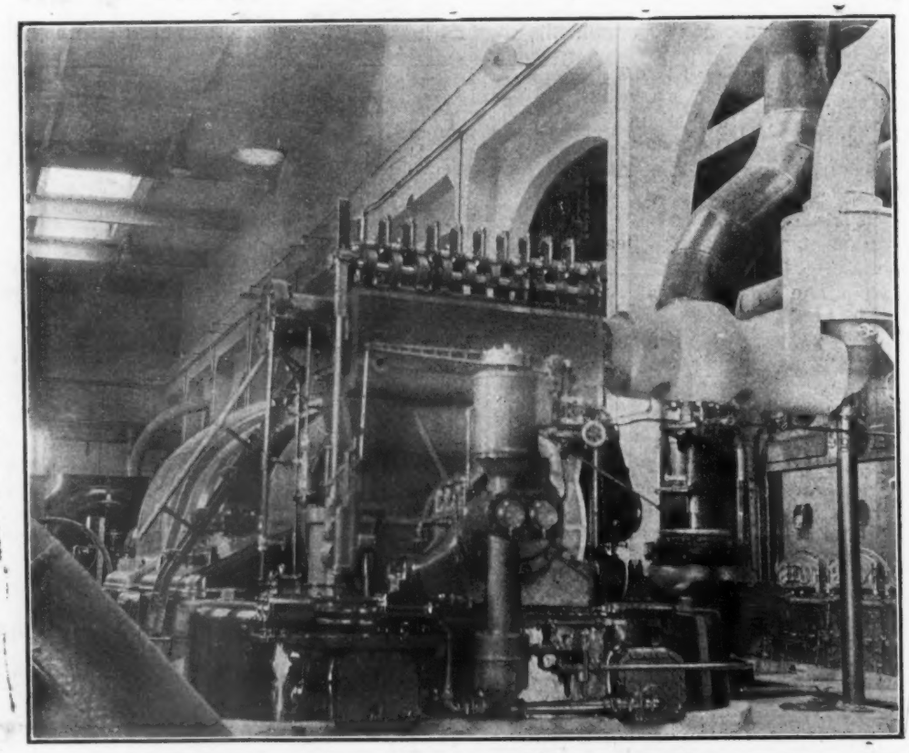


FIG. 78—5000-KW TURBO-GENERATOR IN SAN BERNARDINO STATION

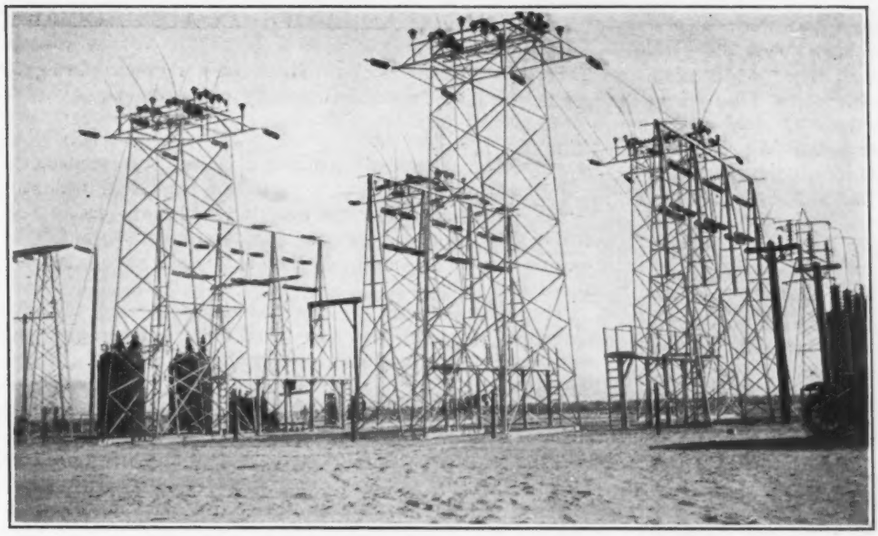


FIG. 79—SUBSTATION AT LONE PINE

ing the generating voltage of the reserve steam station which is situated near the substation. Owing to the proximity of the steam plant, a transfer truck is provided for moving any of the transformers into the station if necessary to repair or overhaul them. After a transformer is taken into the station a 40-ton jib crane is used to lower the transformer into a pit and disassemble it.

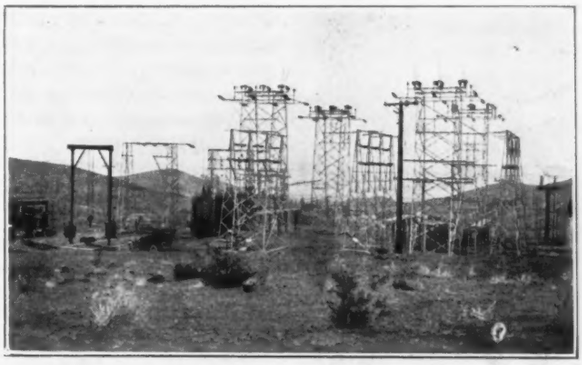


FIG. 80—SUBSTATION AT RANDSBURG

At this substation there is a set of shunt inductance coils for artificial loading at times when the synchronous machines in the station are off the line and the load on the 33,000-volt feeders is light. These inductors are of the air-core type and are made up of six units. Three Westinghouse three-pole oil switches are provided for putting the coils in service, the switches being arranged with interlocking mechanism so that the order in which the coils are connected to the line will be such that the least possible disturbance will result. The coils have a combined rating of 1900 kva and are connected to the 33,000-volt bus. Their action has proved quite satisfactory, and at the present operating voltage of 55,000 the inductive reactance of the six coils is sufficient to hold the receiving terminal voltage of one of the 240-mile lines down to about normal value.

Imperial Valley Line

The latest addition to the system mileage is the extension from the southern terminal of the tower line of the Southern Sierras Power Company to the Imperial Valley. This wonderfully fertile section of the country has been handicapped by the inadequate local supply of electricity, a condition brought about by the phenomenal growth of the towns and industries of the Imperial country.

To supply the needs referred to a line reaching from San Bernardino to El Centro is being constructed. The new line is of wooden-pole construction with No. 000 aluminum conductor, spaced 72 in. in an equilateral triangle, on Locke insulators. The total length of the line is 166 miles, the present voltage of transmission being 55,000.

At Banning, Coachella and Imperial Junction there will be substations of 900 kva rating each, and at El Centro, the southern terminal, three 1250-kva transformers are being installed. The latter are of the General Electric outdoor type with radiator-style cases and three distinct windings for 55,000, 17,000 and 2200 volts respectively. A 2000-kva, 2200-volt synchronous condenser set is installed at El Centro for regulating the voltage at the receiving end of the line. The condenser operates in connection with a Tirrill regulator and will be kept floating on the line at all times.

On account of the extreme heat at El Centro, a canopy covering of corrugated iron is provided for protecting the transformers from the direct rays of the sun. A Kelman oil circuit-breaker protects the El Centro station transformers on the high-tension side, this switch being mounted, as is the one at San Bernardino, on a

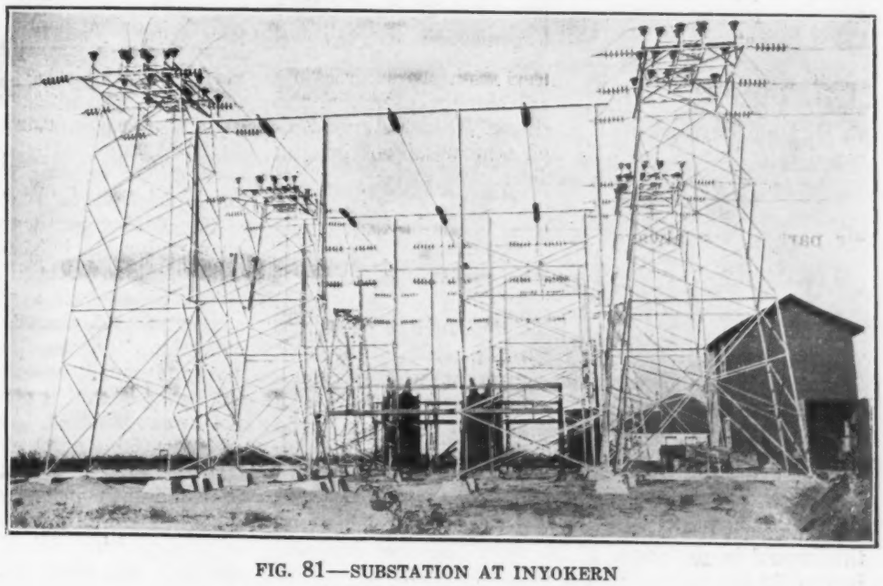


FIG. 81—SUBSTATION AT INYOKERN

30-ft. galvanized-steel tower and fitted with both disconnecting and grounding switches. From the 17,000-volt bus energy is distributed to the neighboring towns of Brawley, Holtville, Calexico and other points. It is intended to change from delta to star connection as soon as the voltage of the system is raised to 87,000.

The foregoing represents a typical hydroelectric system designed to meet the varying and ever-increasing

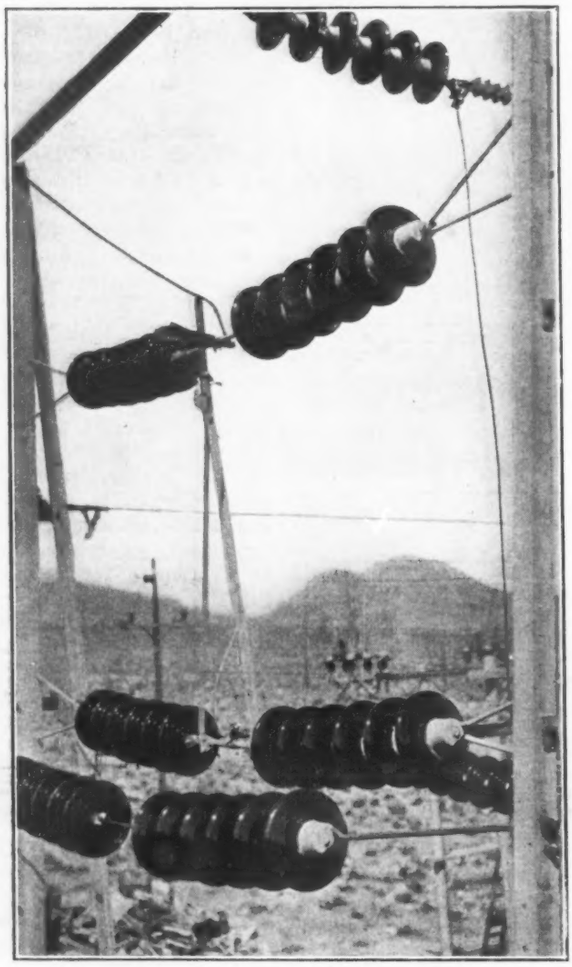


FIG. 82—DISCONNECTING SWITCH USED ON 87,000-VOLT LINES

conditions of service. The author wishes to express his sincere thanks to Mr. R. G. Manifold, engineer, and Mr. R. H. Halpenny, assistant engineer, for assistance rendered in collecting the data and otherwise contributing to the preparation of this article.

Electricity Versus Steam in Railroad Practice

A New Haven Railroad official is quoted as saying: "Upkeep of electric engines is on the order of 5 cents to 7 cents per locomotive mile per 100 tons of weight. Steam-locomotive maintenance runs anywhere from 8 cents to 25 cents, depending upon nature of the coal and water used—an average figure of 11 cents would not be bad. With regard to pounds of coal burned for electric-engine versus steam-engine haul, a pound of coal burned under the boilers of a central electric station for such traffic will develop twice the drawbar pull that would be developed if the same pound of coal was burned in the firebox of the steam locomotive."

ELECTRIC AUXILIARIES ON AUTOMOBILES

Three-Unit, Two-Unit and Single-Unit Systems Designed for Lighting, Starting and Ignition Purposes

By George T. Hanchett

THE problems of lighting, starting and ignition on automobiles have created an electrical industry which requires the activities of many large factories, and the larger electrical companies, realizing the extent that the business has attained, have also entered the field.

There is perhaps no more difficult problem to solve satisfactorily than the supply of electricity to gasoline automobiles. Many requirements must be met: First, the apparatus must be reliable; second, it must be light; third, it must conform to limited space conditions and unfavorable surroundings; fourth, it must be cheap, and, fifth, it must comprise both low and high voltage alternating-current and direct-current outputs.

For ignition purposes nothing has proved more reliable than the so-called high-tension magneto. This peculiar machine is a combination generator and transformer. It invariably comprises a shuttle armature revolving in a strong permanent magnetic field in synchronism with the engine that drives it and that it supplies with electricity. A low-voltage coil builds up a current on short-circuit through a breaker opened twice each shaft revolution. The sudden cessation of current within the armature produces an impulse in a high-voltage coil, the output of which is distributed by an appropriate commutator to the spark-plug to be fired. A condenser is usually added to reduce the spark at the breaker and a safety spark-gap is installed to protect the high-voltage circuits. The breaker acts on the crest of the current wave.

So perfectly has this device been developed that the magneto has become one of the most reliable parts of a gasoline automobile. The history of buzz coils, batteries and the like has been so unfortunate that builders have been reluctant to abandon the magneto even when a substantial dynamo and storage battery have become available to provide a practically unfailing source of electrical energy. The confidence of many makers is such that they depend on the magneto alone for ignition, discarding the dry battery and spark coil as a dual auxiliary which was popular in the early days of magneto development.

Systems for Providing Electricity

This merited confidence in the magneto has been a large factor in creating the following systems for providing electrical energy:

(1) A three-unit system, comprising a magneto, a generator and a starting motor.

(2) A two-unit system, which may be of two kinds —combined lighting and starting with a magneto, or combined lighting and ignition with a starting motor.

(3) A single-unit system, in which a single machine as a motor starts the engine and as a generator provides energy for both lighting and ignition.

The single-unit systems are of two kinds—directly connected and geared. The directly connected system comprises a flywheel generator which is quite expensive and usually weighs at least 30 per cent more than the flywheel that it replaces when casing and field magnet are considered. As a motor it is expected to operate at from 90 r.p.m. to 150 r.p.m. As a generator it operates at from 300 r.p.m. to 1500 r.p.m. As a motor it usually consumes from 600 watts to 1000 watts. As a generator it is required to deliver about one-tenth of that power. All of the operations must be at substantially the same voltage.

This calls for design conditions which are disadvantageous to the apparatus. The torque conditions are sometimes very severe, especially in new cars that have been shipped a long distance or across the sea, and in cars that have many cylinders or valve sleeves and have stood for a long time in cold weather. In a test made on a hundred new cars with 35-hp motors, the torque at shipment was measured and found to average 180 lb.-ft.

The maximum torque must be dealt with. The form of the torque curve is of less importance, for, though it is a means of estimating the energy per start, that is very small in view of the short time the starting power is applied.

Series characteristics are therefore desirable on starting, while for running as a generator the requirements are those of a regulated shunt machine.

The voltage of operation is always low; 6 is a popular standard, but 12 and even 24 have been used, and, as there are no volts to spare if any are to be left to overcome back emf and give speed, the series turns must be bulky and massive.

The writer designed and patented one of the first automobile generators ever built. The object was to store the surplus energy of the engine at times of light load and to feed the energy back automatically when the gasoline engine felt the distress of heavy torques and slowed down in meeting them. The automatic starting feature was incidental, and while recognized as an advantage it was not at that time considered so necessary as it is to-day. The machine performed full duty both as generator and motor, and it is not without its advantages, in spite of the drawbacks of weight and cost. It is foolproof and silent, two compelling advantages in automobile work which make the machine popular on high-priced cars. Heavy as it is, it displaces the flywheel and, though it is distinctly heavier in the net than some other types, the difference is not so great as at first might be supposed. This generator provides starting and lighting energy in a most satisfactory way, for it is usually coupled with an ample storage battery somewhat larger than required, and the machine, being large in dimensions for its output, must be built into the car and designed with the power plant. A multipolar generator with from six to eight poles is invariably used.

For ignition recourse is had to a synchronous make-and-break arrangement, a condenser and a coil, the energy being taken from the storage battery. This system, if well made, is very satisfactory and has but one weakness—the failure of the battery from evaporation and sulphating due to long periods of inattention. This objection has impelled many makers to spend a little more money and install a high-tension magneto, thus providing a two-unit system.

Another Form of Single-Unit System

A second form of single-unit system operates on the same electrical principle, but the motor is connected to the engine by chains or gears. The motor speed is higher, and therefore the machine itself lighter and less costly, but it displaces no flywheel weight, and in the net little, if any, gain in weight is had. Being smaller in bulk for the duty, it is easier to design for better efficiency and smaller storage battery. It is, however, more noisy and requires two more bearings and moving parts. Ignition is provided in the same way as in the other unit, and though at first the make-and-break system with coil was used, a separate magneto was eventually installed, so that it may be truly said that genuine single-unit systems are daily becoming scarcer.

With one exception, all other automobile electric systems employ for starting a separate motor which performs no other duty. The duty is so brief that enormous overloads are permissible. Any feasible battery will fail before the motor becomes distressed.

High torque is obtained by a series field and very small clearance. One-sixty-fourth of an inch is used successfully by one maker who grinds his core disks to insure concentricity. Everything can be sacrificed to torque. Sparkless commutation is of secondary consideration. The result is a very light, efficient motor with surprising output, size considered.

The system is complicated by the necessity of mechanically disconnecting the motor after the engine has started, and this requirement often presents formidable difficulties. The small high-speed motor requires a reducing gear often twenty, and seldom less than ten, to one. As a speed of 1000 r.p.m. is not uncommon in automobile engines, it is plain that after the engine starts immediate mechanical disconnection is imperative. The most popular means of connection and disconnection is by clash or sliding gears. This is mechanically barbarous. In transmission work it is bad enough to mesh the gears when the speeds are more nearly alike, but in starter work the speed conditions are either rest for the flywheel gear and an unloaded series motor speed for the meshing gear on starting or extreme tooth speed of both gears at the moment of disengagement.

It is plain that the engaging and disengaging means must be certain and sure or broken gear teeth will result. Needless to say, much sad experience has been gained due to poor design or mismanagement on the part of the user.

One maker has solved the problem by ingenious means. The motor armature slides within the field structure lengthwise with the shaft. It is normally held out of the field structure by a spring. The first action of the series field is to draw the armature into it and slide the pinion into mesh before it is fairly revolving. The revolutions then proceed until the engine takes hold, when the load comes off the motor. The field weakens with the reduced load, and the pinion and armature are retracted promptly and automatically by the spring before the engine has a chance to reach a speed that would endanger the motor. No mechanical levers are needed, only the electric connections. The device has the disadvantage that it must be geared directly to the flywheel, which limits the ratio to nine to one or less, thereby requiring a larger machine. Care must be had to break the electric circuit promptly to avoid series speeding, though a small shunt coil could be advantageously added to prevent a runaway.

Other starting motors of this single-duty type employ double reduction motors. A sliding gear worked with mechanical levers is used and the electric switch is simultaneously closed. The noise of the gears grows in volume as the engine starts until it reaches sufficient magnitude to scare the operator into letting go of the handle, which usually is spring-controlled and retracts the offending pinion automatically.

The makers of these motors have wisely refrained from supplying the mechanical connections. This is left to the automobile designer and his peculiar school of engineering. Necessity and circumstance often cause him to violate successfully all accepted laws of conservative mechanics, yet most of the solutions offered have given a reasonable degree of practical satisfaction.

An Offered Solution

An interesting solution of the problem has been offered in the shape of a friction drive on the rim of

the flywheel. This has the doubtful disadvantage of slipping, but when surface velocities are widely different, as they often are, it is a positive blessing. Engagement is instant, and slipping when in engagement can be reduced by the accepted forms of V-groove friction wheels or the employment of composition friction wheels, one of which, made of canvas placed edge on radially under heavy pressure, is notably good.

Still another starting means involves the use of a ball or roller clutch driven by the motor and surrounding the shaft to be started. The engine runs away from the clutch when it speeds. There are no mechanical levers, and only an electric circuit needs to be closed. A shunt coil is of advantage here to prevent series overspeeding when the circuit is held closed too long.

One single-unit system employs sliding gears for starting and switches to a second and more favorable driving ratio for driving the machine as a generator. This effects an economy in the size of the double-duty electric motor but at the expense of some mechanical complication. A coil and breaker in connection with a battery is used for ignition purposes, but the tendency to use a separate magneto is strong and often the customer makes such a substitution.

The next tendency is to obtain energy for ignition and lighting from a single unit, leaving the separate starting motor to do its duty alone. The principle is simple. A generator is synchronously geared to the engine and carries on the end of its shaft a breaker. By the aid of a differential field winding and a small differential cut-out part of the output is used in charging the storage battery without the aid of other regulation in spite of the variable speed at which the unit is driven. Sometimes this regulation is augmented with a potential magnet actuating a vibrator which short-circuits a resistor in connection with the shunt field. A coil in combination with the breaker and battery with a suitable high-tension distributer provides energy for ignition. This system has the advantage of giving a fat ignition spark regardless of speed, but the disadvantage of being wholly dependent on the storage battery, which may suffer owing to the user's neglect.

The Three-Unit System

For these reasons the three-unit system has found favor—a generator for generating, a magneto for ignition and a motor for starting, all designed to fit their various duties. The pioneer days scarcely ever found these three things existing separately. The easiest way was to use them. Now the luxuries can become disabled without involving the necessities.

The single duty of the three units permits the best electrical design. The temporary duty of the starting motor permits close clearance and compact structure and very light weight, and the only disadvantage is the complicated and numerous mechanical appliances.

To sum up in tabular form, the following advantages and disadvantages obtain:

Type of System	*Advantages*	*Disadvantages*
Single unit directly connected.	Simple, easy to operate, slow speed, reliable, long life.	Weight, cost, ignition on battery; three duties on one machine.
Two units, starting and lighting, directly connected.	As above.	Weight, cost.
Single unit, gears or chains.	Single, easy to operate, light, compact.	High speed when operating as generator; ignition dependent on battery; three duties on one machine.
Two units, starting and lighting, in one, gears or chains.	As above.	High speed under dynamo operation.
Single unit, gears or chains; two drive ratios.	Light, compact.	Requires skill to operate; apt to be noisy on motor operation; ignition dependent on battery; complicated mechanical connection.
Two units, starting and lighting combined; two drive ratios.	As above.	Complicated mechanical connection; requires skill to operate; apt to be noisy on starting.
Two units, ignition and lighting combined; starting separate.	Light, compact.	Complicated mechanical connection; requires skill to operate; noisy on start; ignition dependent on battery.
Three units.	Light; all machines at best efficiency; non-interference of various duties.	Complicated mechanical connection; skill needful to operate; noisy on starting; difficult to make neat installation.

It is easy to see that the advantages and disadvantages of all of the systems are so many and varied that it is not surprising that each has many advocates, and as these are often ardent, impelled either by commercial considerations or technical pride, it is well to say in closing that the disadvantages cited are relative and that any of the systems mentioned will give a reasonable degree of satisfaction. The survival of the fittest remains to be determined.

Experiments with Crystals of Metallic Selenium

Prof. F. C. Brown, State University of Iowa, Iowa City, in speaking before the American Physical Society on fundamental electro-mechanical, photo-electrical and electrical relations in crystals of metallic selenium, said that his work had shown that light of all portions of the visible spectrum alters the conductivity of crystals of metallic selenium of two systems. Furthermore, when the light is removed the recovery is rapid. If the entire crystal is illuminated, equilibrium is reached in less than 0.2 second. The maximum sensibility for a given amount of energy is in the ultra-violet.

Selenium crystals are in equilibrium such that a pressure of 180 atmospheres will increase the conductivity a hundredfold. Specific conductivity of the crystals also increases with the applied voltage. While light action may be transmitted almost undiminished throughout the crystal, pressure effect is not transmitted outside the region affected by the mechanical stress.

The effect of an applied electric potential is not transmitted beyond the region of the electrical stress, nor does it manifest itself except in the direction of the electrical field. The absolute sensibility of the crystals to light increases with mechanical pressure and is proportional to the relative conductivities for corresponding pressures in the dark. If a crystal is partly under pressure, this increased sensibility takes place only at the place where the pressure is applied. But the increase of sensibility holds for the transmitted light action as well as the direct action of light. The action is transmitted in the crystal at a rate greater than 2 cm per second.

Internal and External Heating Have Same Effect on Wire

Prof. H. L. Dodge, State University of Iowa, experimenting on the comparative effects of electric heating and external heating upon the elasticity of mild-steel, copper and aluminum wire, has found that the effects of internal and external heating are the same. With increases in temperature Young's modulus decreases for all metals, it is declared, with increasing rapidity. Professor Dodge described his experiments before the recent Chicago meeting of the American Physical Society.

Characteristics of the Three-Wire Generator

Analysis of its behavior when used as a balancer in a direct-current lighting system. By O. J. Ferguson

THE invention and development of the three-wire distributing system for lighting created a demand for machines or combinations of machines which present, for connection to these three mains, three points—namely, the positive terminal, the negative terminal and also the neutral terminal. With alternating current and the use of the transformer this presents no difficulty. But direct-current circuits preceded alternating-current circuits in commercial application to lighting.

The conditions were successfully met in direct-current practice by numerous devices. Among them may be mentioned the most important as follows:

Two generators were put into series with each other, each one generating the voltage necessary for one incandescent-lamp unit. This is diagrammatically shown in Fig. 1. Equally successful is the combination of a

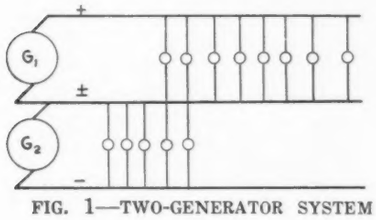


FIG. 1—TWO-GENERATOR SYSTEM

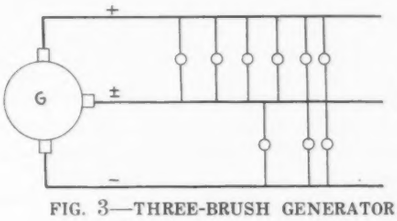


FIG. 3—THREE-BRUSH GENERATOR

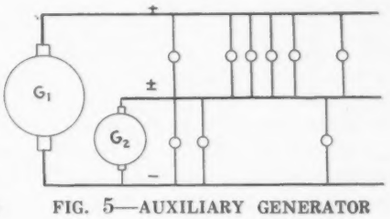


FIG. 5—AUXILIARY GENERATOR

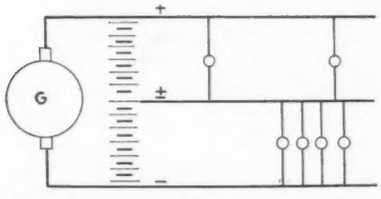


FIG. 2—GENERATOR AND BATTERY SYSTEM

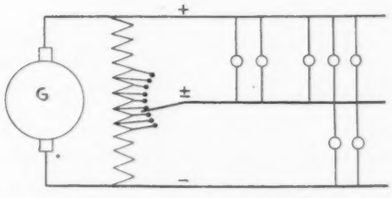


FIG. 4—GENERATOR AND RESISTANCE SYSTEM

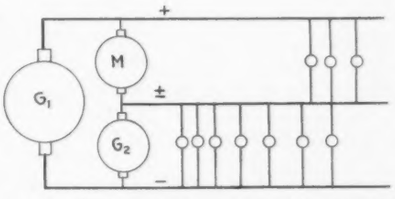


FIG. 6—BALANCER SET FOR THREE-WIRE SYSTEM

single generator with a storage battery thrown across the line, the mid-point of the latter furnishing the neutral lead (Fig. 2). Besides these, various other designs were more or less satisfactory.

Three brushes may be used as in Fig. 3. This has the disadvantage that it places a brush upon the commutator at the most objectionable point—where the coil short-circuited by it is generating a high value of electromotive force. The region in which the auxiliary brush is placed can be made neutral by a suitable design of the generator. This might mean a gap in the pole face.

Resistances may replace the storage battery, as in Fig. 4. It is quite evident that this system must be very evenly balanced or serious losses occur in the resistances. Moreover, the resistances must be high or there will be a heavy current flowing through them even on a balanced load.

An auxiliary generator may be used (Fig. 5), of some capacity smaller than the main generator. A "balancer set" may be thrown across the line as in Fig. 6. Here the functions of the motor and generator, respectively, change if the load is unbalanced in the opposite sense from that shown. In some cases double-commutator generators are used.

The most successful single-unit system ever devised for this service is called the three-wire generator. Fig. 7 represents one form of this machine. A generator is provided with the ordinary commutator, positive and negative brushes, besides which it has two slip-rings connected at diametrical points of the armature. A compensator is connected across this alternating-current circuit from ring to ring. From the mid-point of this compensator winding a lead is brought out for the neutral connection.

The vector for the alternating-current circuit and the direct-current vector always bisect each other, no matter what the position of the armature (Fig. 8). Hence the center point of the compensator winding is always the neutral point of the armature.

If the two points of the armature, A and B (Fig. 7), are not diametrically opposite, the alternating-current vector will revolve tangent to a small circle concentric to the emf circle, as in Fig. 9, and the brush-to-neutral voltage follows a cycle of the form:

$$e = r^2 + a^2 + 2ar \sin \theta.$$

In the circuit of the compensator or reactance coil there will always be flowing an exciting current of such a magnitude as will produce normal flux in the core. This, by design, is kept small.

When the load upon the system is balanced there is no return current in the neutral and, therefore, the only current in the reactance coil is the small exciting current. When the load is unbalanced a current is produced in the neutral, in either one direction or the other, depending upon the direction of the unbalancing.

In order to be explicit, assume an unbalancing, as shown in Fig. 10, where, also, the reactance coil is shown as if connected directly across the armature

permanently and the neutral is brought out from its center point. If this unbalancing amounts to $2i_0$, the relation holds that

$$I_1 = I_2 + 2i_0.$$

At the connection point C the current $2i_0$ divides *equally* and i_0 is its value in each direction from the center. The relation is most easily seen by referring to the magnetic circuits.

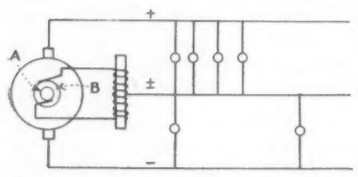
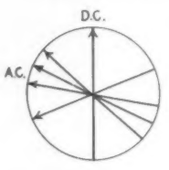
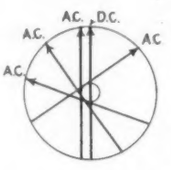


FIG. 7—THREE-WIRE GENERATOR SYSTEM





FIGS. 8 AND 9—VOLTAGE VECTORS, TRUE AND MISPLACED NEUTRALS

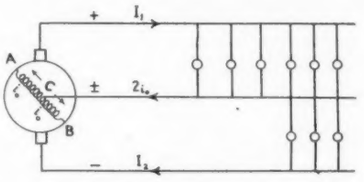


FIG. 10—CURRENT DIVISION IN THE REACTANCE COIL

Coil AB is permanently connected across the armature, and hence has impressed upon it the alternating emf of the machine e_x (Fig. 12). There flows the exciting current i_x. A flux φ will be set up in the core, lagging slightly behind the current and practically 90 time degrees behind the emf e_x.

If e_x is a sine wave, the flux will follow a sine wave of time value also, but i_x will assume the ordinary excitation current wave of a core where iron is present in the magnetic circuit. The flux will link with both halves of the winding.

If, now, an extra current i_0 is produced in one-half of the winding, in the same direction as i_x, there will be an increased number of ampere-turns upon that half of the core and the flux will be increased. But the actual total flux must follow the definite cycle shown in the figure. Hence the current in the second half of the winding must be such as will counteract the effect of the extra current in the first half. This means that it must also have an excess current of i_0 in a direction opposed to the exciting current.

When the circuit is followed to the point A (Fig. 10) another division of current occurs. This partition is not so easily described.

If the circuit at this point be divided and the parts be lettered as in Fig. 13, the current i_0 may be considered as equal to the sum of the two components i_1 and i_2.

$$i_0 = i_1 + i_2 = i_3 + i_4$$

These currents, i_1, i_2, i_3, i_4, are not recognizable either by meter or oscillograph, for they do not exist independently.

In each section of the armature there flows the current below noted.

In A, $i_a = i_2 - i_3 - 0.5I_2 - 0.5i_x$.
B, $i_b = i_1 + i_3 + 0.5I_2 - 0.5i_x$.
F, $i_f = i_3 - i_2 - 0.5I_2 + 0.5i_x$.
D, $i_d = i_4 + i_2 + 0.5I_2 + 0.5i_x$.

Of these component parts, I_2 may be made equal to zero by completely unbalancing the load. The exciting current is generally very small and hence only slightly affects the total when that total is anywhere near to normal load. Because of this we may consider without serious error, for a wholly unbalanced load, that currents are:

$$i_a = i_2 - i_3,$$
$$i_b = i_1 + i_3,$$
$$i_f = i_3 - i_2,$$
$$i_d = i_4 + i_2.$$

Moreover,

$$i_0 = i_1 + i_2 = i_3 + i_4.$$

Therefore,

$$i_a = -i_f$$
$$i_0 = i_a + i_b = i_d + i_f.$$

In solving the problems, we may deal either with the component parts, i_1, i_2, i_3, i_4, or with the real currents, i_a, i_b, i_f, i_d.

Upon the current distribution in the armature depends the heating, and therefore the rating, of the machine. When no unbalancing occurs the wave-shape of the current in any conductor is rectangular, reversal occurring at each brush. Here the current cycle (Fig. 14) is the same for all conductors.

Dr. E. J. Berg has worked out what the ratings may be when unbalancing occurs, basing his calculations upon the assumption that the component currents change by the straight-line variation. Such an assumption may be illustrated by Fig. 15. During the first half revolution, counting time from the instant when A and B pass the positive brush, we have the conditions already noted:

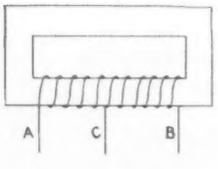


FIG. 11—MAGNETIC RELATION OF TWO PARTS OF REACTANCE COIL

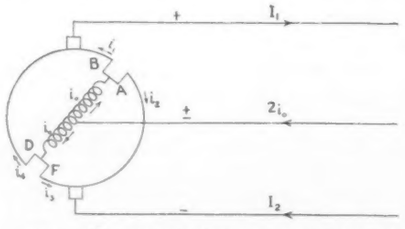


FIG. 13—UNBALANCED-CURRENT DIVISION IN THE ARMATURE

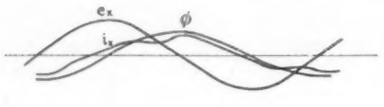


FIG. 12—EXCITING CURRENT IN REACTANCE COIL

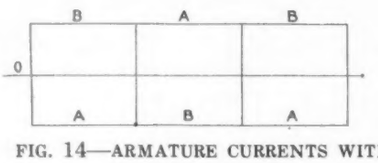


FIG. 14—ARMATURE CURRENTS WITH NO UNBALANCING

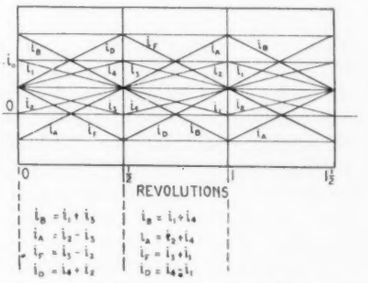
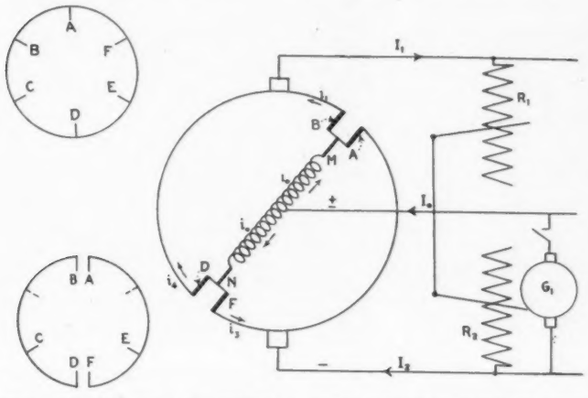


FIG. 15—ARMATURE CURRENTS AND THEIR COMPONENTS, ASSUMING A STRAIGHT-LINE VARIATION OF THE LATTER

$$i_b = i_1 + i_2.$$
$$i_a = i_2 - i_3.$$
$$i_f = i_3 - i_4.$$
$$i_d = i_4 + i_2.$$

When a half revolution has occurred D and F commutate and interchange values, the direction of gradual change remaining the same in each case as it was before. That is, i_2 always *decreases*, except for the commutation change; i_4 always *increases*, except for the commutation change. At the point of commutation, however, they would interchanuge values, i_2 becoming large and i_4 becoming zero. The positive brush is now upon the commutator at some point intermediate to A and F.



FIGS. 16, 17 AND 18—NORMAL RING CONNECTIONS OF CONVERTER, SPIRAL RING CONNECTIONS, AND CONVERTER CIRCUITS AS USED IN THE TESTS

Hence, the current relations are:

$$i_b = i_1 - i_4.$$
$$i_a = i_2 + i_4.$$
$$i_f = i_3 + i_1.$$
$$i_d = i_4 - i_1.$$

If, now, the component currents are straight-line curves, then the actual currents will follow straight lines also. From the assumption that the currents i_1, i_2, i_3, i_4 follow straight lines is necessarily derived the result that the currents i_b, i_a, i_f, i_d follow straight lines.

Of course, it is quite evident that this statement is not reversible. For if i_a were known to follow a straight line variation, it might be made up of two components, each differing from a straight line, the one in one direction, the other in the other direction, by like amounts.

In order to secure data upon the current wave, the writer has proceeded as follows:

A four-pole, sixty-cycle synchronous converter, rated at 10 kw, 62.5 amp, 160 volts, direct current, was used as a three-wire generator. The rings are normally connected at A, B, C, D, E, F, of Fig. 16. The armature was opened at the diametrical points A and D. Rings B and F were detached from their proper position in the winding and connected as shown in Fig. 17. Although readings were not to be taken at D and F, it was found necessary to open the circuit at this point and insert resistances equal to those at A and B in order to balance the two halves of the armature against each other.

Fig. 18 shows the development of circuits for this scheme. The heavy lines at A, B, M, F, D, N indicate German-silver resistances inserted as mentioned in the preceding paragraph.

Balanced and various unbalanced loads were put upon the machine. Between the neutral main and the negative main provision was made to balance R_1 by means of R_2, or to secure any degree of unbalancing. Furthermore, a generator was equalized-in between these two lines, allowing energy to be supplied to this half of the armature.

TABLE I—READINGS FOR LOAD DISTRIBUTION

Fig. No.	21	22	23	24	25	26	27
I_1	30.0	30.0	30.0	30.0	30.0	30.0	30.0
I_2	30.0	20.0	10.0	0	−10.0	−20.0	−30.0
I_0	0	9.0	19.0	29.0	39.1	49.1	59.0
$2E$	120.0	120.0	120.0	118.0	118.0	118.0	120.0
i_m	0	6.5	11.0	16.0	20.8	26.5	32.5
i_n	0	5.5	10.7	16.2	20.3	24.7	29.8
i_a	14.3	12.4	10.4	10.6	11.8	13.4	16.0
i_b	14.1	12.3	10.5	10.6	11.7	13.7	16.2
i_f	13.8	11.0	10.3	10.2	11.1	12.7	15.4

Readings and curves were taken for the load distribution:

I_1	30	30	30	30	30	30	30
I_2	30	20	10	0	−10	−20	−30

Oscillograms of currents in A, B and M were taken. These curves are shown in Figs. 19 to 25, inclusive. The readings are given in Table I.

These readings and curves present several noteworthy points.

Within the ordinary range of accuracy, the meter readings indicate that:

$$I_1 = I_0 + I_2.$$
$$i_m = i_n.$$
$$i_a = i_b = i_f.$$

Each of the curves is toothed with a much higher frequency than the fundamental. It appears that the number of teeth per cycle upon any curve shown is equal to the number of armature slots for two

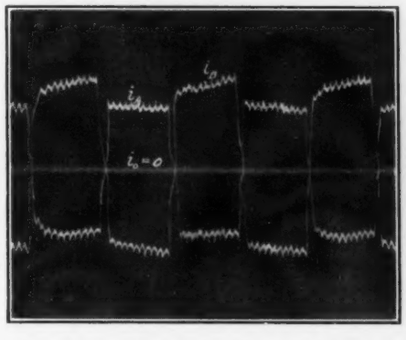


FIG. 19—ARMATURE CURRENTS WHEN $I_1 = 30$ AND $I_2 = 30$ (UNBALANCED STATE)

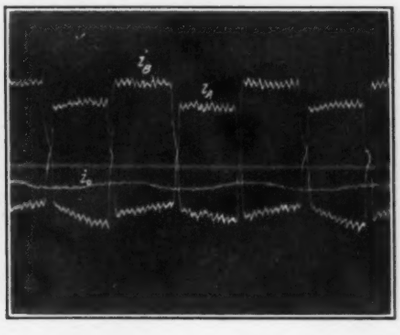


FIG. 20—ARMATURE CURRENTS WHEN $I_1 = 30$, $I_2 = 20$ (PARTIAL UNBALANCE)

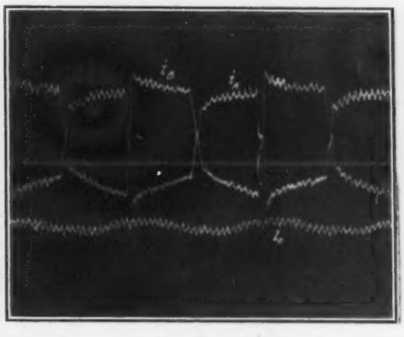


FIG. 21—ARMATURE CURRENTS WHEN $I_1 = 30$, $I_2 = 10$ (PARTIAL UNBALANCE)

poles. We conclude that these higher harmonics are caused by the varying reluctance of the magnetic path as the teeth pass in front of the poles.

The cross-over from one condition to the other at commutation does not occur instantaneously but requires a time about sufficient for the passage of two armature teeth from under the pole face. The self-inductance of the coil in which current is being reversed and the width of brush are the cause of this delay. The brush is sufficiently wide, however, to allow a complete reversal of current in the short-circuited coil or even to build up too great a current in the proper direction. This is much a matter of brush shift as well as width of brush.

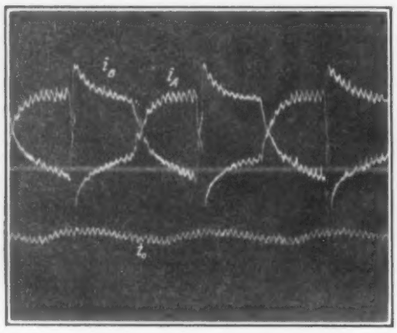


FIG. 22—ARMATURE CURRENTS WHEN $I_1 = 30$, $I_2 = 0$ (COMPLETE UNBALANCE)

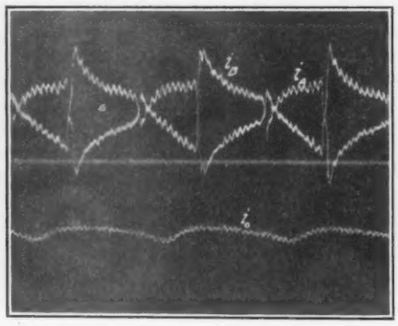


FIG. 23—ARMATURE CURRENTS WHEN $I_1 = 30$, $I_2 = -10$ (DIRECT-CURRENT CONVERTER)

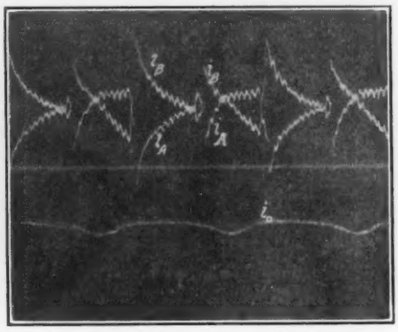


FIG. 24—ARMATURE CURRENTS WHEN $I_1 = 30$, $I_2 = 20$ (DIRECT-CURRENT CONVERTER)

The reversals are illustrated by special photographic records taken for this purpose and showing the effect of short-circuiting an armature coil by a brush with backward and with forward shifts. (See Fig. 26.) The commutation peaks of the curve (i.e., the peaks occurring due to the short-circuiting of the coil under the brush) are reversed in direction by reversing the brush shift.

From a study of Figs. 19 to 25 it becomes evident that the component currents cannot be straight lines because their combinations are not such lines. These latter are, rather, broken curves whose successive sections resemble exponential curves.

As before noted, the indication that i_a and i_b are logarithmic does not require that i_1, i_2, i_3, i_4 be logarithmic. However, this is a natural supposition, while if we test this hypothesis we get no negative results and everything seems to point toward satisfactory explanations of the observed results.

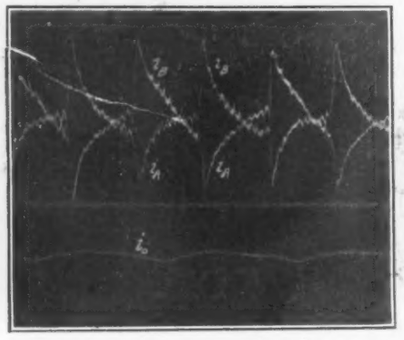


FIG. 25—ARMATURE CURRENTS WHEN $I_1 = 30$, $I_2 = -30$ (DIRECT-CURRENT CONVERTER)

For example, i_1 may fall off through the entire revolution of the armature along any one of the curves shown in Fig. 31. Assuming curve i_1 would fix i_2, i_3 and i_4 (with present conditions), for

$$i_2 = i_0 - i_1,$$

and i_3 is identical with i_1 except that it occurs a half revolution later. Most satisfactory results were obtained by assuming that the final value of i_1 was equal to about $(3/8)i_0$, this assumption giving results coinciding fairly well with oscillograms.

Theoretically derived, the curves appear as in Fig 32, which has been developed as follows:

Current i_1 is assumed as above noted. Then during the first half revolution

$$i_a = i_2 - i_3 - (0.5)i_x,$$
$$i_b = i_1 + i_3 - (0.5)i_x,$$

while during the second half revolution

$$i_a = i_3 + i_4 - (0.5)i_x,$$
$$i_b = i_1 - i_4 - (0.5)i_x.$$

Neglecting i_x will give the smooth curves shown in dotted lines in Fig. 32.

The exciting current is very small compared with the load current. It is distorted and is of the shape always seen in the presence of iron. Combining this with the other curves will give the solid curves named i_a and i_b. These derived curves are almost identical with the oscillograms for wholly unbalanced loads. (Fig. 22.)

If resistances A, B, M, F, D, N are unbalanced, we shall get such curves as are shown by curves 27, 28, 29, 30. These correspond to 19, 20, 21, 22, respectively, with balanced conditions of resistances.

In the mathematical solution of the problem difficulties are encountered which indicate that the present statement of the problem is not sufficient fully to determine the values of the component currents. This is evidenced by undetermined coefficients in the final expression for the current.

FIG. 26—CURRENT IN ARMATURE COIL, SHOWING EFFECT OF BRUSH SHIFT ON SHORT-CIRCUITED VALUES

Let $\frac{di}{dt} = p$

e = voltage reading between positive brush and M (Fig. 18).

e_o = voltage *generated* between the same two points.
r = resistance of one coil.
L = self-inductance of one coil.
N = total number of coils upon the armature.
ω = displacement of M from positive brush.

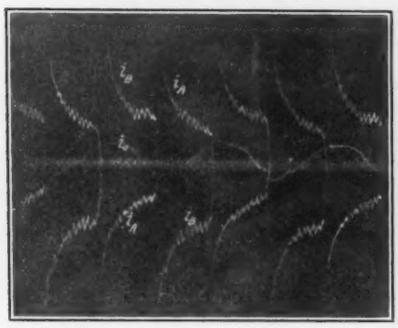


FIG. 27—CONDITIONS AS IN FIG. 19 EXCEPT FOR UNSYMMETRICAL RESISTANCE IN ARMATURE

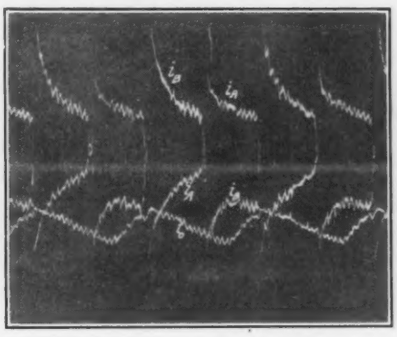


FIG. 28—CONDITIONS AS IN FIG. 20 EXCEPT FOR UNSYMMETRICAL RESISTANCE IN ARMATURE

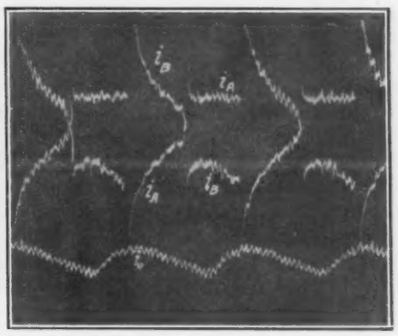


FIG. 29—CONDITIONS AS IN FIG. 21 EXCEPT FOR UNSYMMETRICAL RESISTANCE IN ARMATURE

As the coils are distributed in the winding, it is assumed that the inductance will vary as the number of coils, rather than as the square of that number. Mutual inductance is probably negligible.

Using the actual currents which occur in the windings, we have:

$$i_a = -i_f,$$
$$i_b + i_a = i_o, \text{ whence } p_b = -p_a;$$
$$i_d - i_a = i_o,$$
$$i_b + i_d = 2i_o, \text{ whence } p_b = -p_d.$$

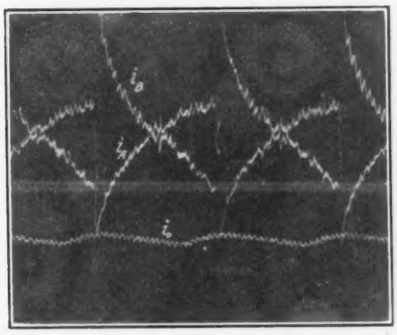


FIG. 30—CONDITIONS AS IN FIG. 22 EXCEPT FOR UNSYMMETRICAL RESISTANCE IN ARMATURE

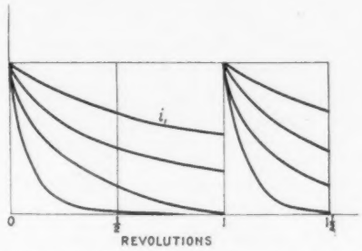


FIG. 31—POSSIBLE VARIATIONS IN ONE COMPONENT OF THE UNBALANCED CURRENT

Therefore:

$$e = e_o - i_b r \frac{N\omega}{2\pi} - Lp_b \frac{N\omega}{2\pi}.$$

$$e = e_o - i_a r \frac{N}{2} - L\frac{N}{2}p_a - i_d r \left(\frac{N}{2} - \frac{N\omega}{2\pi}\right) - L\left(\frac{N}{2} - \frac{N\omega}{2\pi}\right)p_d.$$

Then

$$i_b r \frac{\omega}{2\pi} + Lp_b \frac{\omega}{2\pi} = i_a \frac{r}{2} + i_d r \left(\frac{1}{2} - \frac{\omega}{2\pi}\right) + \frac{L}{2}p_a + L\left(\frac{1}{2} - \frac{\omega}{2\pi}\right)p_d.$$

$$Lp_b + i_b r - i_o r\left(\frac{3}{2} - \frac{\omega}{\pi}\right) = 0.$$

Or:

$$\frac{di_b}{dt} + i_b \frac{r}{L} = i_o \frac{r}{L}\left(\frac{3}{2} - 2 \text{ ft.}\right).$$

This equation is integrable by:

$$i_b = A\varepsilon^{-\frac{r}{L}t} + Bt + C.$$

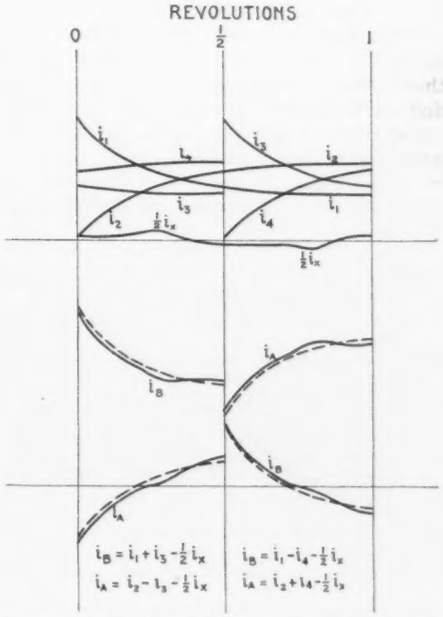


FIG. 32—AN EMPIRICAL DEVELOPMENT TO APPROXIMATE FIG. 22

Where

A is indeterminate.
$B = -2f\, i_o$.
$C = \left(\frac{2fL}{r} + \frac{3}{2}\right)i_o$.

Therefore:

$$i_b = A\varepsilon^{-\frac{r}{L}t} - 2f\,i_o t + \left(\frac{2fL}{r} + \frac{3}{2}\right)i_o.$$

The known condition that

$$i_2]_{t\,=\,1/2f} = i_3]_{t\,=\,1/f}$$

is not sufficient to determine the value of A.

Conclusions

(1) The values of the component currents i_1, i_2, i_3, i_4 need not be fixed for a given value of load current, because the interrelation of components may change while retaining the same totals.

(2) Similarly, for a fixed load, the currents i_a, i_b, i_f, i_d need not bear a fixed relation to each other.

(3) The assumption of logarithmic shapes for the component currents seems justified.

(4) Neither in the component currents nor in the actual currents do the transient terms reduce to zero and disappear.

(5) The magnetizing current of the reactance coil slightly distorts the actual current curves from the exponential form.

(6) The load remaining constant, an unbalancing of resistances leads to relations between the component currents and the actual currents differing from those assumed in Fig. 32 and illustrated in Figs. 19 to 25, inclusive. The new results are illustrated in Figs. 27 to 30 inclusive.

COSTS OF ELECTRICAL EQUIPMENT

Tabulation of Expense Based on the Experience of an Eastern Company Serving a Populous District

The collection of equipment and construction cost data by central stations furnishes a helpful basis in estimating the expense entailed by proposed extensions or changes of plant. It is unfortunate that on almost every construction job local factors appear in the summarized vouchers which make it difficult for engineers in other places to make complete use of the data assembled; but this does not invalidate the value of such data in the form of selected items. In the accompanying tabulations are given various costs drawn from the vouchers of a central station in the East serving a community of 160,000 inhabitants, the items being mainly those which can plainly be identified and utilized as a guide in other work, uncomplicated by incidental matters of a local nature which were not recorded by the company in sufficient detail to be of use. All costs apply to the period between July 1, 1913, and July 1, 1914.

TABLE I—COST OF 15,000/2300-VOLT TRANSFORMER SUBSTATION EQUIPMENT, ERECTED IN FACTORY DISTRICT, BUILDING NOT INCLUDED.

Six 500-kva step-down transformers	$6,600.00
Fifty-four ventilator blades	22.75
One switchboard panel, 48 in. by 16 in. by 1½ in.	9.45
One 5-in. pipe bend and couplings	18.25
Fifteen disconnecting switches, 300 amp, 15,000 volts	138.60
Teaming transformers 2 miles to substation	18.00
Three 22-kva, single-phase, sixty-cycle induction feeder regulators	2,187.50
Wire, 136 ft., 750,000 circ. mil	88.40
Sixty-five 16,500-volt insulators	86.29
Three sixty-cycle no-voltage relays	29.16
Material and labor of installation	3,128.65
50 ft. of 150,000-circ. mil. wire and 200 ft. 1½-in. pipe	29.83
Total cost of equipment installed, including incidentals not summarized in above tabulation because of insufficient data	$12,728.72

TABLE II—COST OF EQUIPMENT FOR THE GENERATING PLANT

One 4500-kw, high-pressure steam turbine, 175 lb., 100 deg. superheat, 28 in. vacuum, 50 per cent continuous overload capacity, directly connected to a 6250-kva, sixty-cycle, three-phase, 13,200-volt generator; one condenser, low-level, jet type, 28 in. vacuum when condensing 88,500 lb. steam per hour when supplied with injection water at 70 deg. Fahr., complete with turbine-driven pumps, and one 6-in. constant-pressure valve for low-pressure steam line from auxiliaries, with 6-in. opening in turbine casing; total, not installed	$58,345.00
One condenser, complete	8,980.00
One 45,000-cu. ft. turbine-driven blower, delivered	2,532.25
One three-phase motor, ½ hp, 220 volts, sixty cycles	99.89
Three oil-immersed, water-cooled automatic regulators for 110-volt circuit	3,050.00
Three 2300-volt regulators	2,664.00
One 15-hp, 220-volt induction motor for 8-in. pump	223.82
Pipe, 140 ft. (6-in. size)	21.00
One aluminum-cell, 12,000-volt lightning arrester	360.00
Cable, 1,000,000 circ. mil., 1450 ft	2,102.50
One 8.5-in., 300-lb. steam gage	12.15
Six 600-amp disconnecting switches	54.60
Three water-cooled sixty-cycle, 2000-kva transformers, 13,200/2300 volts	6,700.00
Wire cloth, 300 sq. ft	9.00
One graphic voltmeter, 90-130 cycles	42.10
Two sixty-cycle, 50-watt, 2200-volt potential transformers	36.00
One 5-amp, sixty-cycle power-factor indicator, 110 volts	40.50
One 5-amp (1500-kw) polyphase indicating wattmeter	56.25
One 7-in. oil filter press	370.20
Fourteen 8-in. tubes	41.16

TABLE III—UNIT COSTS OF TRANSFORMERS*

Rating	Number	Amount	Cost Each	Cost per Kw
Watts				
500	20	$299.88	$15.00	$30.00
1000	1	18.74	18.74	18.74
2000	11	274.93	24.99	12.50
Kilowatts				
1	22	522.81	23.60	23.60
1.5	12	325.51	27.12	18.00
2	15	467.70	31.20	15.60
2.5	10	343.88	34.38	13.70
3	7	265.21	37.88	12.62
4	5	227.93	45.58	9.11
5	9	582.34	64.70	12.94
7.5	13	868.35	66.70	8.90
10	9	715.96	79.55	7.96
15	7	791.83	113.12	7.50
25	6	912.40	152.06	6.08
30	1	173.60	173.60	5.78
40	7	1826.33	260.90	6.52
50	12	3384.24	282.02	5.64
75	6	2084.54	347.42	4.63
110	3	1110.80	370.26	3.36
125	3	1294.93	431.64	3.46
150	4	1976.02	494.00	3.29

*The first three transformers in the table were sign transformers; the others were mainly of 2300, 550, 220 or 110 volts. The prices given are factory prices

TABLE IV—UNIT COST OF METERS*

Amp	Number	Amount	Cost, Each
5	2236	$15,921.16	$7.15
10	83	612.62	7.35
15	33	210.24	6.36
20	92	729.21	7.91
25	9	100.09	11.12
30	26	284.21	10.90
40	32	396.51	12.40
50	18	277.76	15.40
60	18	259.04	14.40
80	18	288.92	16.05
100	16	283.22	17.70
120	5	139.36	27.83
125	1	41.17	41.17
150	34	1,201.93	35.40
200	7	159.68	22.81
300	1	54.87	54.87
400	4	135.03	33.76
500	1	55.15	55.15

*Factory prices.

Central Station Management

Devoted to Discussion of Administrative Policies, Commercial Methods and Current Practice Among Successful Utilities

How High Money Rate Aided Business

The tightness of the money market during the early months of the European war has not been without its beneficial side to the commercial departments of some central stations, despite the general depression in most classes of business. With interest rates forced to a high figure, manufacturers who were required to make factory extensions to care for growing business hesitated to add investment to their isolated plants and so sought service from the central station. Power users whom the central-station salesmen had never been able to secure before, under normal business conditions, were easily taken over during the period of high money rates. An automobile concern in Milwaukee which has always operated its own plant, despite the educational efforts of the local central station, recently ordered central-station service for its factory extensions. The entering wedge thus driven will, it is believed, be the means of introducing central-station service into the factory on a still larger scale after the relaxation of the financial stringency which was the immediate cause of installing electric motor drive.

Selecting Washing-Machine "Prospects"

To concentrate sales effort on the most susceptible prospective customers for electric washing machines, a central station new-business manager in a Western city recently adopted a rather unusual procedure. He called about him his sales staff and informed the solicitors that they were to begin work at 6 a. m. the following Monday, instead of 8:30 a. m. as usual. Their work in the early hours, he said, would consist in making trips afoot over as great a part of their territories as possible, traversing the alleys and byways and noting where the washing was being done at home and in what places husbands were helping with the work.

When the solicitors had reported, lists of the men seen helping with the family washing were immediately prepared and salesmen were sent to show these prospective customers how they could save much time and labor by purchasing electric washing machines. The householders who had to do the work themselves were quick to appreciate the advantage of the motor-driven washers, and it was easy to make sales among this class of "prospects." Circular letters and personal calls by solicitors were later used on the other prospective customers in homes where the manual labor was done by the women of the house or by servants.

A Forty-Dollar Public-Policy Idea

The suggestion which took the second prize, $40, in the Commonwealth Edison Company's recent semi-annual award for meritorious suggestions was offered by Mr. P. F. Williams. In brief he advises that the company advertise its community spirit, showing the general public how a considerable part of the company's funds are expended each year for the good of the community and pointing out how in time the individual is benefited.

To carry out the idea more fully it was suggested that a carefully written yearbook be printed with illustrations showing new buildings erected, street improvements made and new territory built into during the year passed. Adding to these illustrations a statement of the cost of improvements, together with a summary of the plans for the ensuing year, and sending the book annually to each customer, would in time result in general public acceptance of the community idea. Such prevalent acceptance would generally benefit the company.

In connection with the yearbook it was suggested that newspaper advertisements of the same nature be used to call attention at intervals to the company's activities and give interesting facts which intimately concern the public.

Private right-of-way men employed by the company should also be provided with a well-written, illustrated booklet arranged in an interesting and convincing manner, with the community idea as the theme.

Striking While the Iron Is Hot

When the name of a new residence customer is entered on the books of the Topeka (Kan.) Edison Company as an applicant for service a circular letter similar to the one shown herewith is mailed to the lady of the

THE TOPEKA EDISON COMPANY

Topeka, Kansas

"Do it Electrically"

Dear Madam:-

We note your recent order for the installation of our service for Electric Light in your home.

We want to acquaint you with the many applications of electricity for heating, cooking and power purposes, and are sending you enclosed a few pamphlets descriptive of same.

The ELECTRIC IRON is one of the most universally used appliances.

We are offering a special inducement to our customers this month, that all may be equipped with an ELECTRIC IRON.

Until further notice, we are offering you the iron at cost price, $2.50, regular price, $3.50.

Our complete line of other labor-saving electrical utensils should be seen at our office.

We will have on hand a complete line of electrical appliances for the holidays, and would suggest that you place your orders now for future delivery. Make this season's gift an electric one.

Yours truly,

THE TOPEKA EDISON COMPANY.

Phone 4080. 808 Kansas Ave.

FAC-SIMILE REPRODUCTION OF SUCCESSFUL CIRCULAR LETTER

house. The letter coming from the electric-service company at such a time is sure to receive some attention, even under a 1-cent stamp. The chances are that it will be read with care by more than one member of the family and will make a lasting impression. Using

this scheme during the last year, the Topeka company has been able to sell 500 flatirons and double its total appliance business without the aid of special campaigns.

Results of Fall Housewiring Campaign at Kokomo, Ind.

During the autumn the Indiana Railway & Light Company, which operates a central station at Kokomo, Ind. (with a population of 22,000), concentrated its sales efforts on the wiring of already-built houses near its existing distribution lines. A special wiring campaign was started Oct. 15, based on a twelve-month extended-payment offer.

In this campaign the company's agents have secured the wiring contracts by persistent house-to-house solicitation, and the new-business department has then apportioned the orders equitably among the three local electrical contractors at a figure several per cent less than the customer's contracted price, which was itself based on quotations agreed upon by the contractors before the opening of the campaign. This small percentage difference the company receives in order to insure itself against possible losses in the collection of the monthly instalments which are paid by the customers along with their monthly bills for lighting service. Following are the special offers which were made to owners of unwired houses in Kokomo:

Terms of the Four Special Offers

"A-4"—$10.50

Wiring for four outlets, one in each of four rooms, each equipped with cord drop, socket and lamps (carbon, or 25-watt or 40-watt tungsten), one wall snap-switch in living room; all complete and ready to burn.

"A-6"—$16.50

Wiring for six outlets, one in each of five rooms, each equipped with drop cord, socket and lamps (carbon, or 25-watt or 40-watt tungsten), two wall snap-switches, and one outlet on the porch, equipped with porch ball and ring.

"B-6"—$22.80

Wiring for six outlets, one in each of five rooms, two of which are equipped with round-type, two-lamp brass fixtures, one with round-type brass pendent or bracket fixture, two with drop cords, sockets and lamps (carbon, or 25-watt or 40-watt or 60-watt tungsten), two wall snap-switches, and one outlet on porch equipped with ring and ball, all complete and ready to burn.

"C-6"—$32.00

Wiring for six outlets, one in each of five rooms, two of which are equipped with square-type, two-lamp brass fixture, one with heavy square-type, brass pendent or bracket fixture, two with drop cords, sockets and lamps (carbon, or 25-watt, 40-watt or 60-watt tungsten), two wall snap-switches and one outlet on porch with ring and ball, all complete and ready to burn.

Methods of Advertising Campaign

Extensive publicity has been given to the housewiring plan locally. Newspaper display advertisements, billboards, lantern slides and large dodgers in colors have been used. In each case the special offer for wiring four rooms was featured, the advantages named for the customer being: "One whole year to pay, no interest, free inspection, and work guaranteed." Equally low prices and terms prevailed for additional rooms.

As Kokomo is a factory town, the dodger scheme was found to be very effective. The dodgers were hung throughout the various factory buildings and were also posted near the employees' gates. In this way the campaign was carried directly to the factory man with a small cottage, the type of citizen to whom the instalment payment plan would especially appeal.

Another public advertising scheme that brought results was the projection of an announcement of the campaign by means of a lantern on a large screen stretched across the street. This plan proved especially effective on election night when several thousand people were down town to read the election returns which were also thrown on the same screen.

Use of Photographs by Salesmen

As shown herewith, photographs of the various fixture combinations were carried by the solicitors for the purpose of showing prospective customers the exact article they were being offered. The use of the photographs was found to be most advantageous, for many persons who had never had electric service were unfamiliar with the fixtures and fittings, and consequently much of the salesman's time and effort was saved by displaying the photographs. In addition, many misunderstandings which might have occurred when the wiremen appeared on the job as to the identity of the fixtures purchased were prevented by the display of these photographs with their numbers corresponding to the listings on the original contract which the customer had signed.

The work of solicitation has thus far been carried out along systematic lines, an extensive card-index and follow-up system being employed. On Saturday mornings meetings are held and all contractors and salesmen

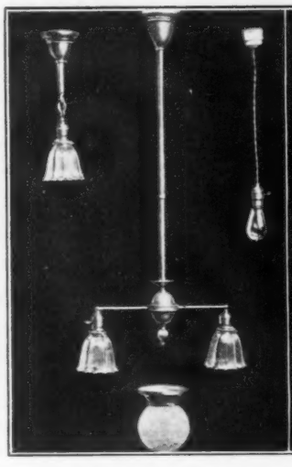


FIG. 1—SIX OUTLETS WIRED AND READY FOR SERVICE, $22.80

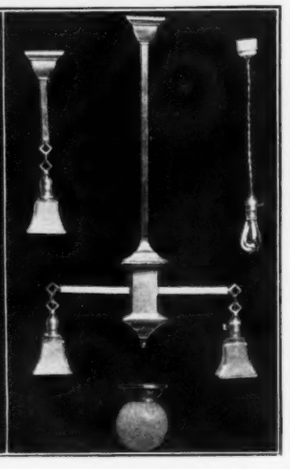


FIG. 2—SIX OUTLETS WITH TWO TWO-LAMP FIXTURES, $32

are urged to be present. Questions of price, specifications and various differences which have come up during the past week are brought up and disposed of in a satisfactory manner. The purpose of these meetings is to perfect and maintain harmony between the contractors themselves and with the central station and its agents—a condition which is, of course, essential if any new-business-getting plans are to be successfully carried out. A banquet and smoker have also been planned to further the good will and co-operative efforts of these men.

Results of One Month's Campaign

The campaign will probably be continued until Jan. 1, 1915. During the first thirty days of the effort 125 house-wiring contracts were secured, at an average cost of $15.83 each. The average size of the houses wired has been five and two-fifths rooms. No poles or transformers have been needed to serve the new customers as all the houses thus far obtained have fallen within gaps along already-existing pole lines. During the last twenty-four months the Kokomo company has also added on its lines 1800 new customers in Kokomo and immediate vicinity. Of this number nearly 200 are rural customers.

Mr. O. M. Booher is the company's new-business manager and is in charge of the house-wiring campaign.

Illumination and Wiring

Ornamental Street Lamps Fed from Underground Cable System for Small Village

Ornamental street lamps like the one shown herewith are being installed at Merion, Pa., for the Merion Civic Association. The units are connected in series by underground cables. To harmonize with the dense foliage which borders the streets the association has employed lanterns resembling those which can be seen outside old roadside taverns in England. The lanterns are hexagonal in shape and are made of sheet copper with flint-glass panes. In each fixture 40-cp 4-amp series tungsten lamps are used. Supporting each lantern is a square cast-iron post bearing in raised letters the name of the village. One hundred and nine of these fixtures

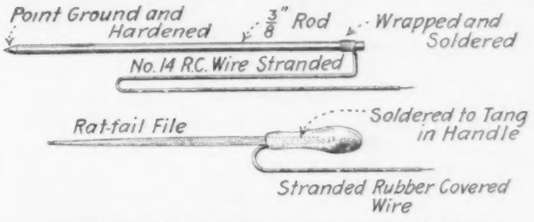
ORNAMENTAL LANTERN FOR STREET LIGHTING AT MERION, PA.

are being erected. Special plows pulled by gasoline engines are employed to make the cable trenches and draw in the conductors. By using this equipment cable is being laid much faster than it could be if the trenches were dug by hand and the cables pulled in by the usual method. The construction work is being done by the Philadelphia (Pa.) Electric Company, which will also furnish energy for the installation when it is completed.

Contacts to Insure Correct Readings in Electrolysis Survey

In taking voltmeter readings for an electrolytic survey contacts may be made with the piping system forming the underground paths by means of the curb boxes, water meters, hydrants or gas drip risers. To make good contacts with these exposed portions of the piping system a 0.375-in. steel rod of sufficient length to reach down into the curb box and rest on the top of the brass cock can be used. One end of the rod should be ground to a sharp point and this point should be tempered. About 20 ft. of No. 14 stranded rubber-covered wire should then be soldered to the other end of the rod to facilitate making connections to the voltmeter. When this rod is inserted into a curb box it should be held carefully so that it will not touch the sides of the box or the ground.

For making contact with the rails a small three-



CONTACT TOOLS FOR ELECTROLYSIS SURVEY

cornered file fixed in a handle is very convenient. A piece of rubber-covered wire should be soldered to the file inside the handle. It is well to remember that serious errors in potential readings may result unless a good rubber-covered wire or other waterproof wire is used, for on a wet day the wire is almost sure to become damp and to cause a ground as it lies in the street or on the wet grass or earth.

Contact-making devices such as those described were used in an electrolytic survey at Salina, Kan., and, according to Mr. W. R. Waggoner, of the Salina (Kan.) Light, Power & Gas Company, the results obtained were very satisfactory.

Miniature Lamps for Table Christmas Tree

For the small Christmas tree used as the centerpiece of the Yuletide dinner table the ordinary Christmas-tree outfit of 14-volt lamps connected eight in series gives an incongruous appearance on account of the large diameter of the lamp bulbs. A much more appropriate lighting decoration can be made for such a small tree by stringing in series a number of little 3.8-volt flashlamp

LIGHTING THE TABLE CHRISTMAS TREE

bulbs, which are less than 0.5 in. in diameter. The tiny lamps are rated to take about 0.3 amp each, and although designed for multiple connection, they are fairly uniform in manufacture and hence operate well in series. For a 3-ft. tree fifteen or twenty lamps will show up well, and for connection to a 110-volt source this number should be connected in series with a 40-watt or 25-

watt tungsten lamp designed for the full voltage. The current through the 40-watt lamp will bring the tiny bulbs up to the intense brilliancy at which they ordinarily operate in the battery flashlamps. For continuous use on the dinner table, however, both the visual comfort of the diners and the life of the filaments will be conserved if the lamps are run in series with the 25-watt lamp. By this means the tiny lamps will be brought up to about the intensity of an old-fashioned carbon-lamp filament, thus simulating more nearly the color of candle flames. The little lamps can be bought at a net cost of from 13 cents to 15 cents each and can be connected by soldering the green-silk-covered jumper wires. At that end of the string which is to light the top of the tree distances of from 7 in. to 8 in. should be allowed between lamps, but the interval should be extended to 12 in. or 14 in. near the bottom of the tree. If desired, the full-sized ballast lamp (which, of course, operates at only fractional brilliancy), can be concealed in and used to illuminate some translucent table ornament, such as a miniature house, head of Santa Claus, etc. The string of lamps described can be made up complete with miniature bulbs, green wire, etc., for $2.50.

Letters to the Editors

Charge for Surplus Power

To the Editors of the Electrical World:

SIRS:—Under the above caption Mr. Henry D. Jackson has dealt with an interesting and important subject in the conduct of the affairs of the central-station business.

I will state in the beginning that I believe that so-called "surplus power" available from reserve apparatus should be sold at a low rate subject to the conditions discussed herein. The extent to which this should be done is a matter which should receive careful consideration from the operator. Local conditions may alter the case materially. To pursue this practice to a degree where none of the fixed charges are considered is unsafe. But to make the rate based on the operating cost plus a portion of the prorated fixed charges is both desirable and necessary.

The important controlling factor to consider is whether or not the "surplus power" is demanded on the peak of the load. If it is, new apparatus must be installed to replace the reserve equipment which is being used. The new apparatus required may be a boiler, engine, turbine or generator; seldom all four. In such a case the rate for service would be based on the operating expenses plus the fixed charges accrued incident to the installation of the new apparatus, with possibly a small proportion of the prorated fixed charges on the whole plant. Unless this matter is carefully calculated, there is danger that the small consumer will be required to pay a prohibitive rate to give the property a fair return. If the small consumer's rate is excessive, there will be no small consumer and the fixed charges will be automatically thrown back on the large consumer.

If the new load does not come on the peak, the plant may be loaded up at a low rate to the point where the peak comes on what was formerly the off-peak and the former peak becomes the off-peak load. In no case should the rate be so low that the fixed charges are entirely ignored. On account of the very large number of kilowatt-hours over which the fixed charges may be distributed in taking on a load of this kind a consideration of a portion of them will not increase the rate materially.

The above statements may be illustrated by a rather simple example. Assume a plant with a 500-kw peak from about 5 p. m. to 6 p. m. in the month of December, which is a common occurrence. Ordinarily, to be safe, a 500-kw reserve unit should be provided. On the ordinary off-peak load we should have in reserve not only the 500 kw but an additional 200 kw or 250 kw, thus making 700 kw or 750 kw in all. This is "surplus power" or, rather, "surplus equipment rating," on which fixed charges continue whether it is used or not. There can be no question of the desirability of putting the 750-kw equipment to work producing kilowatt-hours at a rate slightly above the cost of coal, oil and additional labor, together with a small portion of the prorated fixed charges.

In this connection it is important to consider another phase of the matter. A public utility company is bound by law to serve all applicants under similar circumstances within a reasonable distance of its lines without discrimination. If the output of the 75-kw equipment were all sold and a new applicant desired, say, 200 kw, it would have to be furnished at the same rate as previously made to sell the 750 kw. New equipment would be required and the fixed charges incident to this new equipment would have to be taken out of the profits or loaded onto the small consumer. Manifestly this could not be done without discrimination or raising the rates slightly.

The matter under consideration comes within the principle of considering what is lost by not having rather than what is gained by having. In all rate matters the principle of charging what the traffic will bear is to be considered. Heavy traffic requires a low rate under the law of competition from other sources of power, but before making such a rate the operator should make careful calculations looking far into the future.

Milwaukee, Wis. H. G. D. NUTTING.

A Tribute to Chairman Barker

To the Editors of the Electrical World:

SIRS:—In the sudden passing away of Chairman Barker of the Massachusetts Gas and Electric Light Commission a loss of more than local significance fell upon the two great industries which were associated in his lifework.

A pioneer in public utility regulation, Mr. Barker was probably the source of more applications of supervisory principles in this field than any other man in the country, for it fell to his lot to blaze the trail through many an untraversed wilderness, and well did he mark the pathways of wise policy for himself, his associates and others to follow. Conservative in temperament and judicial in mind, he never failed to appreciate the significance of progress, and while anything like ostentation was utterly foreign to him, he was by more than one leader of thought in the central-station industry appraised as the highest authority in this country in his responsible field.

Constantly his advice was sought outside the State, willingly he strove to meet every demand upon his great store of wisdom, and if all his quiet, unobtrusive responses to calls for advice could be known, the scope and amount of his service would be found amazing. The record of this pioneer commission in the years of his great services is the most tangible monument of his devotion to that far-sighted justice without which state regulation must fail, but with which those who take up the burdens of the industry when others lay them down will carry their service up and down the world and leave it better for their having lived.

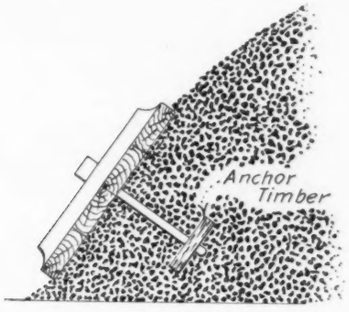
Boston, Mass. HOWARD S. KNOWLTON.

Field of the Operating Engineer

A Record of Practice, Experience, New Ideas and Interesting Problems—Notes on Practical Subjects—Questions and Answers

Anchor Boards for Coal Pile

The accompanying sketch shows a method of preventing coal piles from spreading at the base, by inclosing the lower parts of the pile in courses of timbers anchored from within the pile itself. As the coal is filled in over the anchor timbers the weight of the coal serves

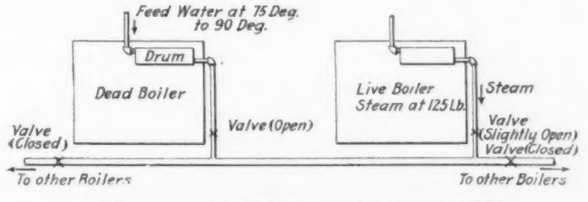


ANCHOR CONSTRUCTION TO PREVENT COAL PILE FROM SPREADING

to keep the outer portions of the pile from spreading. This construction is especially convenient where it is desirable to keep clear a pathway which would otherwise be engulfed by the flow of the lumps of coal. Unless some such protection is used, the jarring and sweeping of passing teams and persons will ordinarily cause the coal to run down a grade very much less than its ordinary angle of repose.

Scheme to Aid Quick Firing of Boilers

The use of electrical energy from transmission lines at Springfield, Mo., has done away with the necessity of operating some of the boilers in the power station of the Springfield Gas & Electric Company. The gas works across the street from the station, as well as the central heating system, still require live steam, but only in emergencies is the entire boiler plant needed. At such times it is necessary to bring some of the "dead" boilers quickly into service. Using the piping arrangement shown in the sketch herewith, it has been possible



PIPING TO AID QUICK FIRING OF BOILERS

to put cold boilers in service at full steam pressure in forty-five minutes. The boiler equipment consists of three 350-hp, one 300-hp and two 500-hp units.

The auxiliary piping used to aid quick firing consists of connections which enable the engineer after lighting the fire to admit both live steam and feed water at 75 deg. to 90 deg. to the empty drum of the dead boiler. To avoid reducing excessively the pressure in the boiler units already in operation, the valve which controls the flow of live steam is only "cracked." Mr. William Smith, engineer at the power station, says this plan has been a success.

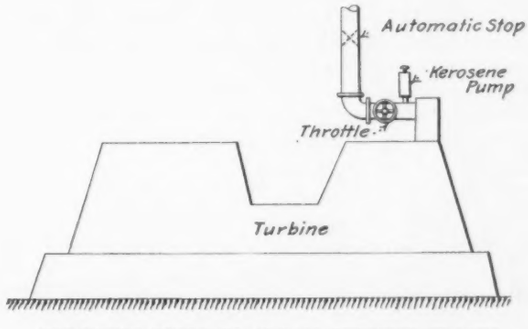
Blowers Connected Directly to Transformer Windings

In stations of the Edison Electric Illuminating Company of Brooklyn where air-cooled transformers are used the blowers are connected directly to the low-tension windings of the transformers. By this means the blower motor is automatically started and stopped when the transformer is energized or de-energized, respectively. A pin-wheel draft indicator is attached to each transformer above the air outlet, so that the station operator is able to tell on closing the transformer switch whether the blower motor is operating properly. The blowers deliver air to a common duct, which is normally divided into sections by dampers. In case any particular blower motor becomes inoperative, the transformer which it cools may be supplied with air from the common duct by opening the dampers at each end of its duct section.

Method of Keeping Turbine Blades Clean

Impure water even though treated is sometimes the cause of a fine coating of lime forming on turbine blades. Lime, magnesia and graphite carried over with the steam from water used in the boilers at Leavenworth, Kan., formed an objectionable coating on the blades of the turbine, making it quite a task to keep the machine clean. But now, since it has been found that kerosene injected into the steam line will clean the blades, the turbine gives no more trouble.

At a convenient spot in the steam line between the



KEROSENE PUMP TO CLEAN TURBINE BLADES

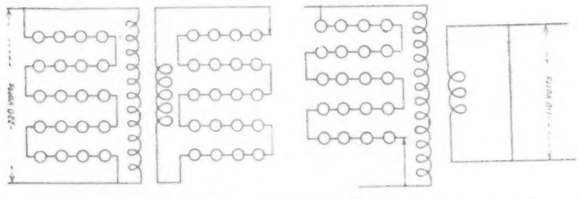
throttle and the valve rigging a small hand-pressure pump has been installed through which kerosene may be injected. Entering thus with the live steam, the oil particles are driven against all blades and only an occasional injection from the pump is needed to keep the blades bright and clean.

Preventing Reversal of Polarity in Rotary Converters

Ordinarily the rotary converters used by the Edison Electric Illuminating Company of Brooklyn are started as direct-current motors, but in emergencies it is necessary to start them from the alternating-current system. To do this without reversing the polarity of the converter a 6-volt storage battery is connected across the field of the machine to maintain the residual magnetism. With the field winding practically short-circuited upon itself it is impossible to induce excessive potentials in the circuit which might destroy insulation or cause subsequent break-down. While the induced magnetism produced by starting the converter as an induction motor may temporarily reverse the polarity of the field cores the storage-battery current will eventually restore it, thereby causing the machine to build up properly. After the machine is once in step the field may be disconnected from the 6-volt storage battery and connected to the normal direct-current supply without reversing the polarity. This equipment has been in use for some time and has produced the desired result when starting rotary converters up to 100 kw in rating on the full voltage of their alternating-current supply. To start larger units it has been necessary to apply only 40 per cent of the supply voltage to prevent the machines drawing too large starting currents.

Determining Approximate Ratio of Transformers Without Measuring Instruments

Frequently it happens that the voltage of a supply circuit must be raised or lowered for making tests or temporarily operating apparatus, but the ratios of the transformers which are available are unknown. In emergencies where voltmeters cannot be obtained for determining the ratio the approximate method described herewith can be employed. Unless there is reason to believe that the unit being tested has a high transformation ratio, twenty similarly rated 110-volt incandescent lamps should be connected across the terminals having the smaller cross-section and one lamp exactly the same as the others should be joined to the other terminals. With 110 volts applied to the latter the lamps in the secondary circuit should be gradually removed until those remaining burn with practically the same intensity as the one across the primary terminals. When a balance is obtained the ratio of the number of lamps in the secondary and primary circuits gives the ratio of transformation. If only high voltage is obtainable for testing the ratio of the transformer and it is known that the unit is designed for operating on this voltage, the method of testing described above may be reversed;

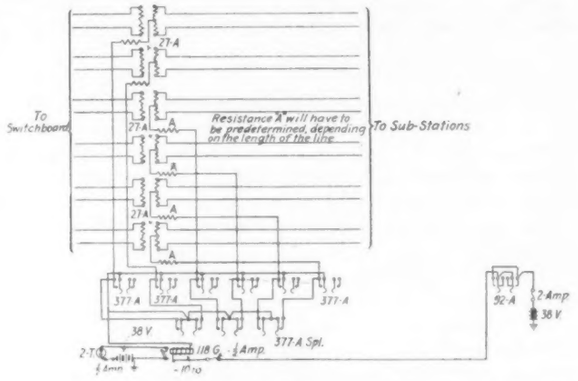


FIGS. 1 AND 2—TESTING RATIO WITH HIGH-VOLTAGE AND LOW-VOLTAGE ENERGY

that is, incandescent lamps having a combined voltage equal to that of the supply circuit should be connected in series across the small cross-section terminals and an equal number of similarly rated lamps across the other transformer taps. The latter should then be gradually removed until the intensity balance is secured, when the ratio can be computed as described above.

Standby Signals Transmitted Over Existing Telephone Circuits

The Edison Electric Illuminating Company of Brooklyn has entered into an agreement with the New York Telephone Company to transmit standby signals from its system operator's office to various substations. Disturbance to telephonic communications over these cir-



CONNECTION OF SIGNALING APPARATUS TO TELEPHONE LINES

cuits is prevented by connecting the signal wires to the middle of coils bridged across the telephone circuits. Single-stroke bells operated by direct current are employed to give the signals. Each station is signaled from its respective key on the system operator's switchboard, which is arranged, however, so that all of the stations can be signaled simultaneously, individually or in groups.

Signals transmitted over this system are intended to notify the operator of the time when storage batteries must be charged and when to make ready for operating equipment. During the time which the system has been in use signals have been transmitted satisfactorily. The testing of the telephone circuits has caused false signals to be transmitted, but this has been the only thing to detract from the successful use of the method.

Effect of Reactance on Paralleling Synchronous Apparatus

What affects the stability of operation of an alternating-current system consisting of several independent generating stations connected in parallel? A. E. R.

The stability of operation of an alternating-current system consisting of two or more generating stations connected in parallel depends on the synchronizing power tending to hold the generators in step. A sudden load or disturbance near one station may cause its generators to drop in speed. The busbar voltage will consequently lag in phase, thereby producing a resultant emf which will cause current to pass locally between the generators the speeds of which have changed relatively. If the impedance of the connecting circuits consist chiefly of resistance and relatively little reactance, the exchange current will be practically in time-phase with the resultant emf and the synchronizing power will be small. On the other hand, if there is little resistance but relatively considerable reactance in the circuit the current will lag behind the resultant emf and be nearer in time-phase with the busbar voltage of the generators the speeds of which have not changed. As a result the synchronizing power will be large and the overloaded generators will be relieved of part of their loads.

Digest of Current Electrical Literature

Abstracts of Important Original Articles Appearing in the Periodical Electrical Press of the World

Generators, Motors and Transformers

Parallel Working of Three-Phase Generators.—F. PUNGA.—An English translation in abstract of his recent German article. The critical GD^2 (kilogram-meter square) of three-phase generators of equal output and speed, but driven by different prime movers, is determined both by calculation and by experiment. A simple formula for the calculation of the natural period of dissimilar generators is also given.—London *Electrician*, Nov. 20, 1914.

Lamps and Lighting

Electric Vacuum Meter.—W. ROHN.—The description of an indicating vacuum meter which permits measuring gas pressures down to 0.00001 mm mercury. It is based on the following principle: If a thermocouple in a vacuum is supplied with a certain amount of heat in a certain time, the rise of temperature of the joint is greater the less energy is abstracted from the thermocouple by heat conduction of the gas. That is, the temperature will be higher the better the vacuum. Radiation losses should be avoided as much as possible. In the instrument (Fig. 1) there are connected in series twenty couples *a* consisting of narrow strips of two nickel alloys (thermo emf = 0.06 millivolt per degree). These are placed between two glass rings of a thickness of 12 mm with a central circular hole of 50 mm diameter. The hole is made air-tight by the plate glass disk *c*. The glass box is connected by means of the tube *n* to the space in which the vacuum is to be determined. The glass box is placed in the thick nickel-plated metallic box, the object being to maintain the cold joints

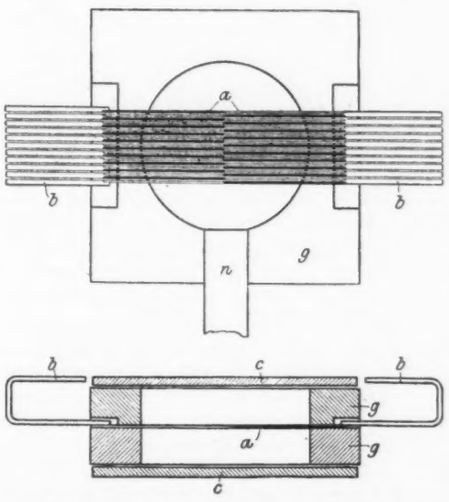


FIG. 1—DESIGN OF ELECTRIC VACUUM METER

on the thermocouples at constant temperature. The metallic box is mounted on a stand, and opposite to it is suspended an accurately adjustable heating lamp (an incandescent lamp of 10 cp and 10 volts) in such a way that the incandescent filament is parallel to and in the same level as a little window in the metallic box, so that the light from the lamp falls on the thermocouples. This arrangement is shown in Fig. 2. The current is carried off from the thermocouples by means of the copper strips *b*. The thermo emf is measured by a sensitive millivolt meter of the D'Arsonval type for 18 millivolts, each scale division representing 0.0001 volt. By means of this instrument it is also possible with

FIG. 2—ELECTRIC VACUUM METER

the aid of a switch to control the lamp current, which is regulated by means of a rheostat. The instrument is intended for use in incandescent-lamp factories.—*Zeit. f. Electrochemie*, Vol. 10, page 539, 1914; abstracted in *Elek. Zeit.*, Nov. 12, 1914.

Traction

Electric Vehicle and the Central Station.—H. BECKMANN.—The present status of electric vehicles in Europe, and especially in Berlin, is illustrated by a table according to the different applications. Besides the other advantages of the electric vehicle, one great point in its favor as compared with other types of automobiles is the universal tendency toward reduction of the price of electric energy as against the very considerable and sudden fluctuations of the price of gasoline. The author shows that the charging of electric vehicles should be a welcome addition to the load of central stations. He recommends that the European central station undertake an energetic propaganda for the electric vehicle according to American practice. Data are given on the charging plant of the central station of Neumarkt in Silesia and the charging station in Hanover Street in Berlin. In fifteen charging stations in greater Berlin there are now consumed annually 10,000,000 kw-hr. The author recommends the way in which the subject is being handled in the United States. He emphasizes that the consumption of gasoline in Germany represents a large amount of money which is lost to the country, as it goes abroad. Taxicabs, omnibuses and freight and delivery automobiles in Berlin alone consume yearly gasoline to the amount of $2,500,-

000. If the electric-central-station managers would solicit the business in a systematic way they should be able to turn at least half of this sum over to the central station.—*Elek. Zeit.*, Nov. 12 and 19, 1914.

Installations, Systems and Appliances

Siamese Central Station.—FRANCIS B. SHAW.—A continuation of his illustrated article on the government electric generating station at Bangkok, Siam. The boiler house is equipped with eight boilers in four batteries, each capable of steaming a 1000-kw turbine set on full load. There are three Curtis multi-stage impulse turbines, coupled to three-phase generators with a continuous output of 1335 kva, or 1000 kw, with a power-factor of 0.75, voltage 3500 and frequency fifty cycles, and running at a speed of 3000 r.p.m. The exciters are mounted on the same shaft. In case of a break-down on the exciters, exciting current may be drawn from the battery, provision having been made for this. The article is to be concluded.—London *Elec. Rev.*, Nov. 13, 1914.

Automatic Voltage Regulators.—CHARLES C. GARRARD.—The conclusion of his illustrated article. As an example of an instrument of the pendulum type, the author describes the Taylor-Scotson regulator. He then takes up regulators of the resistance type and describes the Thury and Brown-Boveri instruments.—London *Electrician*, Nov. 13, 1914.

Wires, Wiring and Conduits

Vulcanized Bitumen Cables.—C. J. BEAVER.—The conclusion of his long paper on cables read before the (British) Institution of Electrical Engineers. The author gives considerable information on the chemistry of the subject. In the present instalment he deals with vulcanized bitumen cables. While there is a general similarity with rubber, there are decided limitations to this resemblance. The cohesion between the particles of material is much less in vulcanized bitumen than in rubber. The author discusses the variation of the physical properties of vulcanized bitumen over a range of temperature and methods of testing. With regard to the chemical properties, the stability of vulcanized bitumen is remarkable. Unlike rubber, it is not appreciably subject to natural deterioration under normal conditions of atmosphere and temperature, and it may therefore be regarded as comparable with paper insulation in that causes of deterioration are practically always extraneous causes. So far as direct chemical attacks which may be encountered in practice are concerned, the material is exceptionally inert to the action of substances of an acid character. It is much more susceptible to the action of alkaline substances. The direct action of such substances is usually, however, only superficial. Even if such waters contain free alkali equivalent to from 25 to 30 grains per gallon (estimated as sodium carbonate), which is considerably above the average for waters encountered in coal mines in England, and the vulcanized bitumen is freely exposed to their attack for two or three years, the depth of penetration of the action is inappreciable. Leaving the causes of deterioration due to direct attack and turning to secondary causes, the susceptibility of alkaline attack must have a great influence under continuous-current fault conditions which can produce electrolytic action, because in most soil conditions it is possible not only to form alkaline substances at parts which constitute the virtual negative electrode of the leakage circuit but to force such substances by osmotic pressure through the dielectric to the negative conductor. Under these circumstances both the direct action on the vulcanized bitumen of concentrated alkaline substances and the aggravated conditions due to the passage of current (producing continuous supplies of deleterious matter and forcing them to the best position for attack) come into play. The author discusses the source of current-producing saponification effects on negative cables and the physically similar but chemically different effects on alternating-current and positive and neutral direct-current cables. Valuable observations were made in the tropics with the following results: First, they showed that leakage played a prominent part in bringing about softening of the vulcanized bitumen and that such currents, even of a very minute order, would produce a type of softening other than that caused by saponification in the well-known manner. Second, moisture must have been a factor in the case, although it was not proved that it had any other functions than that of rendering fibrous coverings and other paths conductive. The relation of the distribution of stains in tape coverings to that of softening of the vulcanized bitumen is confirmatory evidence of its presence. Third, it appeared likely that, in the presence of the two preceding factors, this particular form of softening occurred more readily in tropical than in temperate climates, and that temperature was, therefore, also a factor. (Climate would, of course, affect both the second and third factors, the alternations of temperature and moisture being extreme in most tropical countries.) Fourth, time is obviously important in all changes of the kind under consideration. The softening effects due to the combined agency of heat and moisture (steam) were experimentally reproduced, and in the light of these experimental reproductions hydrolysis of the glycerides of the fatty and hydroxyl acids contained in the vulcanized bitumen was clearly indicated. The results of analysis of the softened material, and a comparison thereof with the results obtained with the original vulcanized bitumen, confirmed this indication. Finally, a description of a method for providing a remedy is given. Some form of colloidal filling having the requisite physical properties to allow of its incorporation with vulcanized bitumen of such composition as not to be capable of decomposition by hydrolytic action, and which at the same time would exert a maximum protective effect when present in small proportion, is clearly required. After much experimental work it was found that high-grade vulcanized rubber could be treated in such a manner that it would fulfil the requirements as regards incorporation with vulcanized bitumen and would, in addition, exert a surprising degree of protection against hydrolytic and selective action, even when used in small proportions. In fact, there was, apparently, some kind of mutual protective action, because the resistance to softening under steam-pressure conditions was greater in the combined substance than in either of its components. It was found that the addition of about 6 per cent of vulcanized rubber trebles the time required to produce the softening and that up to about 12 per cent the time is proportionately increased. When larger proportions are used the curve rapidly becomes steep, and at from 40 to 50 per cent the protection from softening effects appears to be infinite. Remembering that the softening action occurs only under faulty conditions and requires from five to six years to develop a troublesome stage, the protection afforded by from 5 to 10 per cent of the rubber substance would appear to be ample under the worst conditions of practice. An account of the extensive discussion which followed the presentation of the paper is also given.—London *Electrician*, Nov. 20, 1914.

The War and the Electric Wiring Contractor in Germany.—E. WIKANDER.—On account of the war the business of the electric wiring contractor in Germany is in bad shape. In Germany very few new houses are being built, and in the older houses no installations are being made except when some special inducement is made by the central station. The author urges that the

central station should make such inducements not only to help the wiring contractor but also in the interest of the central station itself. For instance, the central station might pay at least part of the installation if the house owner or tenant guarantee to pay back within the next two years yearly 60 per cent of the amount on an instalment plan. Some system of this kind is used by the central station of Genoa, Italy. The central station of Strassburg, Germany, has gone even further and has made the whole installation at its own expense. The result has been that it now sells energy to hundreds of thousands of residences which would not have been electrically lighted otherwise for many years. The municipal plant of Frankfort on the Main has introduced this year a similar system. The author finally refers to the difficulty of importing kerosene into Germany on account of the capture of oil steamers by the British fleet, and he suggests that the German answer should be to introduce electric light universally.—*Elek. Zeit.*, Nov. 12, 1914.

Electrochemistry and Batteries

"Ironized" Steel Tubes.—A note stating that non-corrosive steel tubes will soon be produced in a British plant for ferro-zincing and "ironizing" tubes according to a process of S. Cowper-Coles. It is a well-known fact that the purer the iron the less liable it is to pitting and corrosion, chemically pure iron being practically rustless. "Ferro-zincing" or "ironizing" turns these facts to account by coating the steel surface with almost pure iron, the only impurity of any significance being hydrogen. The addition of hydrogen is an advantage, for the reason that it makes the iron slightly more electropositive to the underlying steel than it would otherwise be, so that it forms a better protective coating. Another advantage of the coating of electrolytic iron is that the coating is homogeneous, and is not under unequal strain caused by mechanical operations, such as drawing or hammering, and has not been subjected to any heat or mechanical treatment, which, of necessity, causes impurities to be absorbed by the metal so treated. It is advantageous for many purposes to coat the electrolytic iron surface with zinc, as a zinc coating with an intermediate layer of pure iron-hydrogen alloy gives a greatly increased life to an ordinary steel tube or plate.—London *Electrician*, Nov. 20, 1914.

Units, Measurements and Instruments

Thermostat for Low Temperatures.—JAMES H. WALTON, JR., AND ROY C. JUDD.—A description of a thermostat which permits one to maintain the temperature constant anywhere between 0 deg. and — 20 deg. C. The general plan consists of a primary bath and a secondary bath. The primary bath is filled with a mixture of ice, salt and water, which is pumped through a coil in the secondary bath. When the temperature of the solution in the secondary bath becomes too low a regulator closes a cock by means of an electric relay arrangement and shuts off the flow of the cold brine. Similarly, when the secondary bath becomes too warm the cock is opened and the flow of brine lowers the temperature. By using a mixture of calcium chloride and ice in the primary bath it is possible to keep the secondary bath at a temperature of from — 25 deg. to — 30 deg. C. The thermostat may also be used at somewhat higher temperatures. For example, ice water could be substituted for the brine solution, and at higher temperatures the primary bath could be entirely replaced by a boiler generating superheated steam.—*Journal Phys. Chem.*, December, 1914.

Miscellaneous

The Engineer and the Chemist.—FRANK BAILEY.—An abstract of his presidential address to the British Association of Engineers-in-Charge on the subject of "The British Empire—and Our Work in It." The author compares the value of exports from Germany and from the United Kingdom in various industries and inquires as to the reason of the apparent failure of Great Britain to take a larger share of the trade. Finance, tariffs and adaptability contribute in some measure to the result. "The weakest link in our chain of progress appears to be the method of ascertaining the right way of going to work. Sometimes it is achieved by actual experience, or, in other words, by trial and error, but rarely by systematic examination. In such an investigation the services of the chemist are generally of great value, although they are seldom appreciated, except in chemical factories. Industrial chemistry can assist the engineer by defining the composition of substances, and when combined with some knowledge of engineering requirements the advice of the chemist is a good investment. In this matter the industrial chemist with a slight knowledge of mechanical engineering is capable of giving better assistance than the engineer with a rudimentary knowledge of chemistry; but it is essential that the engineer should place implicit faith in the chemist and adopt the whole of his advice, as otherwise a partial remedy may introduce new troubles." The selection of metals or alloys and that of lubricating oils, etc., are examples of work in which the chemist can be of great assistance.—London *Electrician*, Oct. 16, 1914.

Book Reviews

KONSTRUKTION UND PRÜFUNG DER ELEKTRIZITÄTSZÄHLER. By A. Königswerther. Leipzig: Dr. Max Jänecke. 520 pages, 554 illus. Price, 16 marks.

A very substantial and carefully prepared treatise on the construction and testing of electricity meters for both direct-current and alternating-current service. It is divided into three sections. The first relates to fundamental principles, the second to the construction of meters, and the third to their testing. The book is copiously illustrated, there being more than one illustration per page on the average. These illustrations, which are well selected, are circuit diagrams, performance curves and pictures of machine parts. Although German meters constitute the bulk of the discussion, French, British, Italian and American meters are also considered. The book will interest all students of electric-power metering, especially those who wish to be informed upon the construction and testing of European meters.

THE ELEMENTARY PRINCIPLES OF WIRELESS TELEGRAPHY. By R. D. Bangay. London: The Marconi Press Agency, Ltd. 160 pages, 86 illus. Price, 1 shilling.

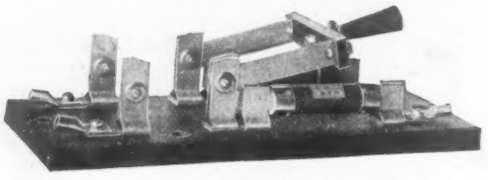
An instructive little book on the theory of radiotelegraphy and some of its applications. The reader who is inclined to study the brief presentation of the elements of electricity and magnetism set forth in the first part of the book should have little difficulty in apprehending the general discussion of wave motion and electrical oscillations which follows. The theoretical bases for the author's concise explanations seem to be accurate for the most part, though the presentation of the subject of pressure waves will lead an unsuspecting student to the belief that "ether waves" are not of transverse vibrational nature. The book is well worth the attention of workers in radiotelegraphy who are anxious to crystallize their conceptions and escape from the prevalent hazy notions as to elementary theory.

New Apparatus and Appliances

An Illustrated Descriptive Record of Recently Developed Manufactured Products of Interest to Electrical Readers

Knife Switch

A knife switch the blades of which can be changed fron one set of clips to another so that the fuse connections can be either at the handle end or the hinge end has been developed by the Frank Adam Electric Com-

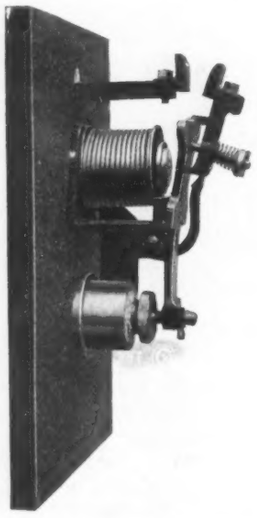


SWITCH WITH BLADES THROWN COMPLETELY OVER

pany, St. Louis, Mo. The change can be accomplished by loosening the compression bolts on the clips with a screwdriver and hinging the knife blades to the opposite set of clips. With such a switch the wireman can make a change on the job without sending for another switch if conditions at the installation should require that the fuse connections be at the opposite end of the switch. In the accompanying illustration the knife blades are shown completely thrown over.

Magnetic Switches

Several kinds of magnetic switches, including a lock-out switch of the series-coil type and improved switches of the shunt-coil type, have recently been developed by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis. The lock-out switch is shown in the accom-



MAGNETIC LOCK-OUT SWITCH

panying illustration and is designed for the automatic starting of motors. High-contact pressures, it is claimed, are obtained with this switch, and there is considerable "follow-up" on contacts to allow for wear. When the flow of energy exceeds a predetermined and adjustable amount the switch remains open, and when it falls below this value it remains closed. On the 100-amp switches the arcing contacts are the energy-carrying contacts also. For the larger switches laminated brush contacts are used to carry the energy, and for arcing auxiliary contacts are provided. The series-wound coil of this switch is divided into two parts, the upper being bar-wound and the lower consisting of copper and asbestos ribbon. The upper section of the coil tends to close the switch and the other part to hold it open.

Metal Sign Receptacle

The sign receptacle shown in the accompanying illustration is equipped with heavy shoulders for holding screws. Wide slots and a guide are provided for leading the holding screws down to the nut. The nuts for the

SIGN RECEPTACLE

holding screws are fastened in place by clips so that they cannot get out of position. The center contact is of phosphor bronze. The device is being made by the H. T. Paiste Company, Philadelphia, Pa., for which the selling agents are the Hart & Hegeman Manufacturing Company, Hartford, Conn.

Porcelain Sockets

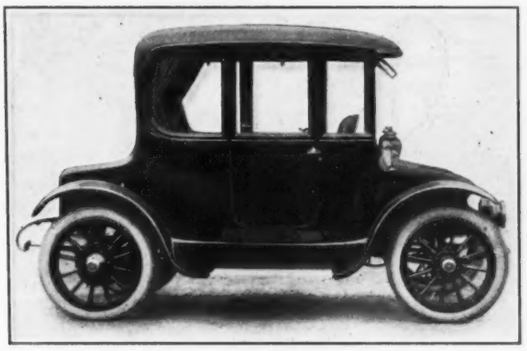
Porcelain sockets equipped with 0.5-in. aluminum caps have recently been developed by Harvey Hubbell, Inc., Bridgeport, Conn. In Fig. 1 and Fig. 2 are shown

FIGS. 1, 2 AND 3—SOCKETS WITH ALUMINUM CAPS

key and keyless sockets provided with pendent caps, and in Fig. 3 a pull socket. The pull socket is rated at 250 watts at a pressure of 250 volts; the key socket at 250 watts at a pressure of 250 volts, and the keyless at 660 watts at a pressure of 250 volts.

Five-Passenger Electric Brougham

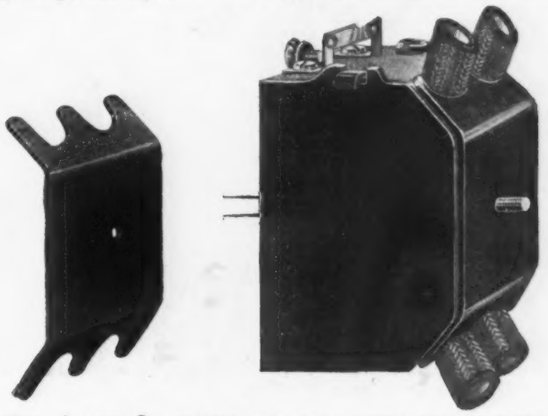
In the latest car developed by the Ohio Electric Car Company, Toledo, Ohio, the body is of aluminum throughout and the window frames are made of solid aluminum castings. The doors are hung on steel hinges and a safety catch is provided on each door which prevents it from flying open when not fully closed. Chainless direct-shaft drive is used with this car, and the motor is suspended by a ball-and-socket joint. The motor propeller shaft and rear axle form one rigid unit. The shaft is directly connected to the motor without reduction gears. The torsion tube, in which the shaft is held concentric by a double row of ball bearings, is connected to the rear axle and to the motor, thereby keeping the shaft in alignment. Either helical bevel driving gear or worm driving gear may be used with this car, as desired. A small disk is used for controlling purposes. By turning the disk in one direction four forward speeds are obtained; an accelerator button which is near the foot adds an extra speed. By turning the disk in the other direction three reversing speeds are obtained. The disk cannot be reversed without pressing a guard button, which prevents the possibility of turning it in the wrong way in an emergency. By pushing a controller-lock button the controller disk is locked and cannot be moved until unlocked by means of a key. The magnetic brake is operated by another button.



1915-MODEL ELECTRIC FIVE-PASSENGER CAR

Clamp for Flexible Non-Metallic Conduit

A clamp for fastening flexible non-metallic conduit or "loom" to switchboxes has been developed by the Adapti Manufacturing Company, Cleveland, Ohio. The clamp shown in Fig. 1 is of sufficiently heavy gage, the manufacturers declare, to withstand any strain that may be placed upon it. In Fig. 2 the device is shown attached to an iron switch box made by the above company. The switch box is provided with a hole in the bottom to which the clamp can be fastened. The clamp itself is provided with a threaded hole. The clamp can be used to hold one, two, three or four conduits in place.



FIGS. 1 AND 2—CLAMP FOR NON-METALLIC CONDUIT

Colored Toy Lantern

A small electric lantern designed especially for use by children has been developed by the American Ever Ready Works, 304 Hudson Street, New York. The lantern is equipped with a colored-glass chimney, and the battery is placed in the case shown in the illustration. A small tungsten lamp is used with the lantern, and both the lamp and the battery can be renewed.

ELECTRIC LANTERN FOR CHILDREN

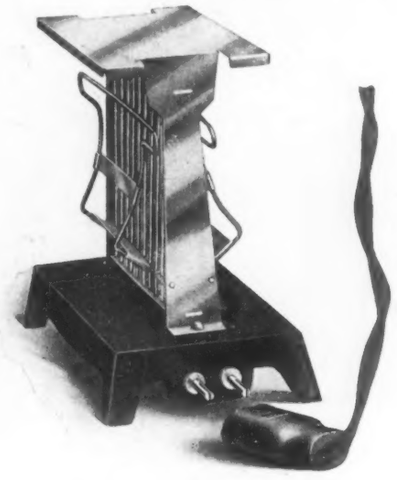
Time Switch

Switchboard devices have been designed for show-window lighting circuits, signboard circuits, apartment-hall lighting circuits, etc., to cut off the supply of energy automatically at a certain definite time, by the Paragon Electric Company, 9 South Clinton Street, Chicago, Ill. Four models of these time switches are being made, two for outdoor use and two for indoor use. A clock and spring motor are used to operate the switch, which for currents of 30 amp or less is an ordinary snap switch. The cases for the outdoor type have a closed face, while those for indoor work are equipped with an open face so that the clock may be employed for designating the time. The switch can be adjusted so as to turn on the lamps at a certain time or turn them off at the proper moment. It will also turn on part of the lamps in a circuit at one time and the others at another time. The adjustment can be arranged so that a day can be skipped if desired. The outdoor types are equipped with heating coils and regulating thermostats to prevent the hardening of oil and the consequent clogging of the clock works in cold weather.

INDOOR-TYPE TIME SWITCH

Electric Toaster

The toaster shown in the accompanying illustration is designed to toast two slices of bread at one time. The top is of plain colonial design, and both top and frame are finished in nickel. A toast holder is mounted



SMALL ELECTRIC TOASTER

on each side of the device. A non-conducting base is provided which is finished in black. The base is heavy enough to prevent the toaster from easily tipping. The toaster is being placed on the market by the Cadillac Electric Manufacturing Company, Cadillac, Mich.

Light-Weight Coffee Percolator

A light-weight coffee percolator made of aluminum and German silver which cannot impart a metallic taste to the coffee has been brought out by the Hotpoint Electric Heating Company, Ontario, Cal. It is provided with a lip-spout similar to that usually associated in the public mind with coffee pots. The heating unit, which is the same type as used in the flatirons made by this company, is guaranteed for five years. It is clamped between a shoulder inside the pot and a nut

ALUMINUM COFFEE PERCOLATOR

in the base so that it can be replaced anywhere. Percolation can be started thirty seconds after pouring cold water in the receptacle and turning on the energy, it is declared. The device weighs only 24 oz. and is highly polished.

Electric Dolly-Type Washing Machine

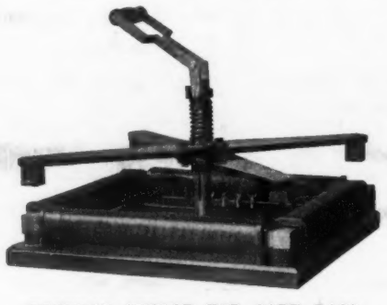
In the washing machine shown in the accompanying illustration three adjustments are provided, one for the wringer, another for the dolly and another for the reversing device. The tubs are of Virginia white cedar

MOTOR-DRIVEN WASHER

and are fastened together by flat, galvanized-steel hoops. The bottoms of the tubs are corrugated, as are also the staves nearly to the top. The dolly is of seasoned hard wood and is equipped with smooth pins. The machine is connected to a 16-hp Emerson motor by rope drive. It has been placed on the market by the Richmond Cedar Works, Richmond, Va.

Core-Loss Testing Outfit

Apparatus for determining the hysteresis and eddy losses of sheet iron and steel has recently been introduced. The equipment consists of a sample holder, a frequency meter, ammeter, voltmeter and wattmeter of suitable rating to make the required measurements, and the core loss is read directly on the wattmeter. The sample holder is shown in the illustration herewith, and consists of four solenoids mounted along the sides of a square wooden base in such a way that when the test pieces are placed in them a continuous magnetic circuit having four equal sides is formed, the corners of the circuit being held firmly down by means of a four-jawed clamp worked with a toggle-joint mechanism at the center. Each of the four coils has a primary and a secondary winding. The four primaries are connected



TESTING OUTFIT FOR CORE LOSS

in series, and the ends are brought out to terminal posts. The secondaries are arranged in the same manner. The outfit is being placed on the market by the Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa.

Four-Cylinder, Single-Acting Vertical Diesel Engines

A large-sized Diesel engine of the vertical four-cylinder, single-acting, four-stroke-cycle, inclosed-crank-case, medium-speed type is shown in the accompanying illustration. The base-plate and frame (crank case) are separate, and large doors are provided for inspecting purposes. The cylinders and liners are independent castings.

The cylinder heads contain the starting, fuel, admission and exhaust valves. The fuel valve is centrally placed in the head. The starting and fuel valves are operated by levers fulcrumed upon an eccentric quill which can be rotated by a hand lever so as to change the position of the valve levers relatively to their cams. With this arrangement the fuel valve levers are out of contact with their cams when the starting valve levers are in contact with their cams. The cam shaft is alongside of and level with the cylinder heads.

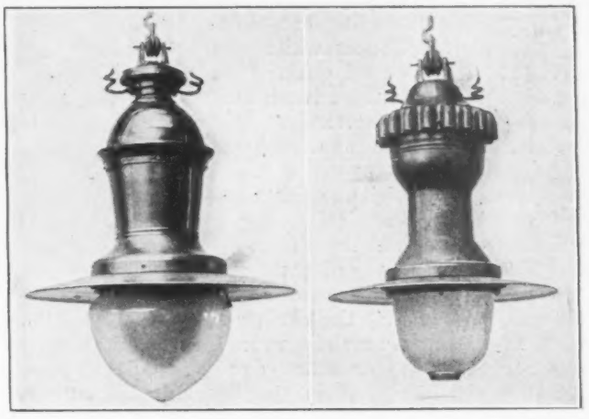
The fuel pump is of the multiple type and is operated from the two eccentrics on the vertical governor shaft, which revolves at engine speed. It gives two discharges of fuel for each power stroke. The governor is designed to keep the suction valve of the fuel pump open over a part of the working stroke of the fuel pump plunger. A three-stage air compressor is used, and it has the appearance of a fifth cylinder on the engine. The compressor is driven from the crank shaft.

The engine is equipped with a forced-lubrication system, the oil being fed at a pressure of 30 lb. per sq. in. For the large-sized units, a device which is automatically operated by the governor is provided for reducing the pressure of the air used for fuel injection whenever the load decreases. The large engines are equipped with another device which automatically adjusts both the period and the lift of the fuel needle. A so-called compression-relief gear is provided to reduce the compression in the working cylinders when starting on compressed air.

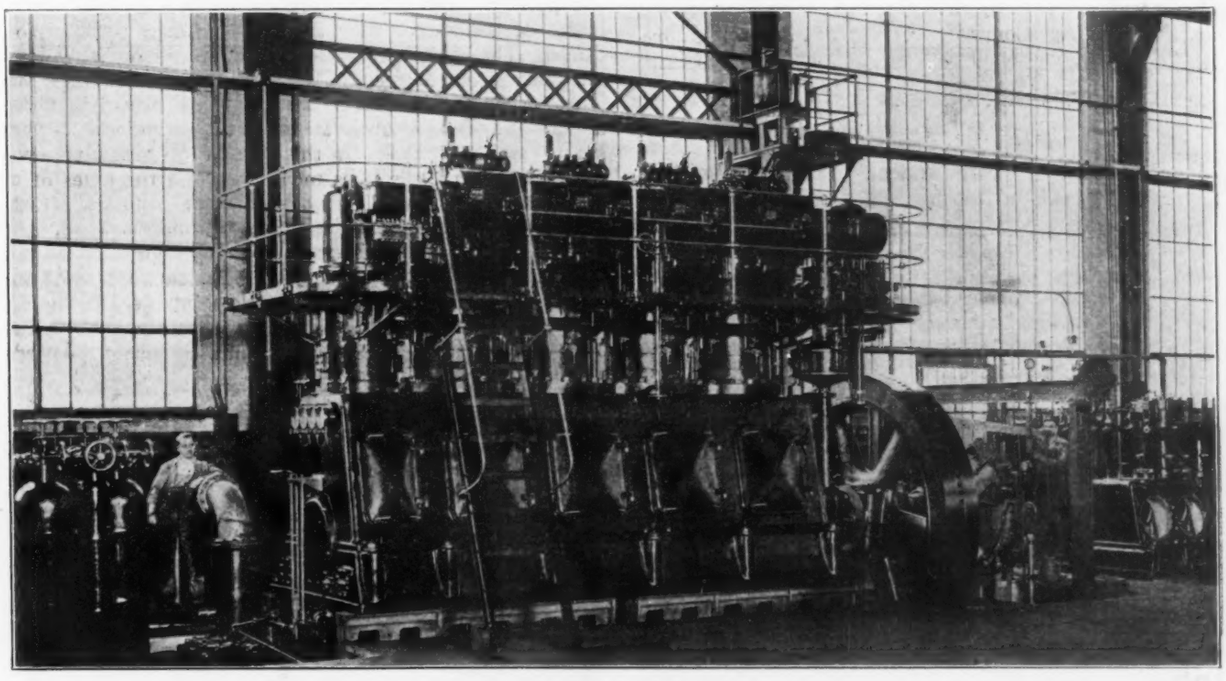
The Type D engine, as it is called, is being manufactured by the Busch-Sulzer Brothers-Diesel Engine Company, St. Louis, Mo.

Fixtures for Street-Lighting Service

Various types of fixtures for use with high-candle-power nitrogen-filled lamps designed for street lighting have been developed by the General Electric Company, Schenectady, N. Y. Two different classes of pendent units have been developed, and they are designated as form 1 and form 2. The form 1 unit resembles the arc lamp in general contour and appearance. This unit is arranged to be equipped with an opal diffusing globe, an opal diffusing globe and concentric reflector, a prismatic refractor and clear globe, or a prismatic refractor. The form 2 pendent units are cheaper than the form 1 fixtures, and they may be equipped with diffusing globe, concentric reflector and diffusing globe, radial-wave reflector, or concentric reflector and prismatic refractor. Both the form 1 and form 2 units are arranged to take a compensator which is mounted under the dome and inside the casing. The refractor has two sections, one inside the other. The company has also designed a unit for ornamental street lighting, mounted on a standard. The lighting fixtures described are called "Novalux" units.



PENDENT FIXTURES FOR NITROGEN-FILLED LAMPS



VERTICAL DIESEL ENGINE

Jobber, Dealer and Contractor

Central-Station Advertisements That Stimulate Dealers' and Manufacturers' Holiday Trade

In a series of five newspaper advertisements which the New York Edison Company is running until Christmas attention is called to the variety of useful and fascinating electrical appliances which can be obtained in department stores or of electric dealers and appliance manufacturers. These advertisements also invite persons to visit the electric-service company's appliance display rooms, where numerous electrical devices suitable for Christmas presents are exhibited. To those who are unable to visit the electric shops it suggests that they consult the electrical directory of the Edison official bulletin to obtain the names of electrical dealers in their locality. In each of these advertisements a number of electrical appliances are mentioned, and the public is advised that the electric-service company will forward orders to manufacturers of electrical goods. Posters bearing the same text as the newspaper advertisements are displayed in the branch-office windows

WINDOW-DISPLAY CARD

of the electric service company at the same time that the corresponding advertisement is being published. Devices mentioned on the posters are displayed in the windows, with cards similar to the one shown herewith, bearing a drawing representing Santa Claus standing beside an evergreen tree decorated with incandescent lamps, while below are the words, "This Christmas give something electrical." Stickers bearing a similar legend and drawing were attached to the consumer's electric service bills.

Preparations for Holiday-Appliance Sale in Brooklyn

By informing residents of Brooklyn of the electrical gift-ware on sale at its appliance display room, both through personal invitations and a conspicuous outdoor sign, the Edison Electric Illuminating Company of that city succeeded in starting its holiday sales early in

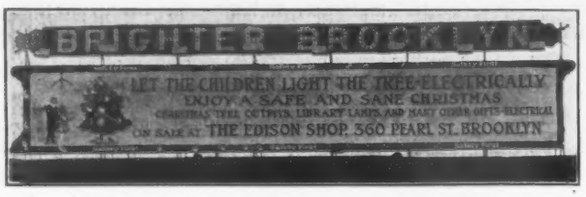

BRIGHTER BROOKLYN
LET THE CHILDREN LIGHT THE TREE ELECTRICALLY
ENJOY A SAFE AND SANE CHRISTMAS
ON SALE AT THE EDISON SHOP 360 PEARL ST. BROOKLYN

FIG. 1—HOLIDAY-SALES BILLBOARD

FIG. 2—INTERIOR DISPLAY

December. Even last year's records, which showed three times the sales of previous seasons, did not come up to this year's result. During the first week of December the rush was unusually large. Many portable table lamps were disposed of, as well as electrical appliances, including irons, percolators, hot-plates, etc. The company's main and branch office display rooms were elaborately decorated, the Christmas shoppers being entertained with music from an electric piano and with refreshments prepared on electrically heated utensils. All articles sold during the holiday season were wrapped in holly-decorated paper, and the purchasers were provided with special Christmas cards, bearing the name of the Edison Shop, on which they could write the name of the person to receive the present as well as the name of the giver. Arrangements were made for delivering the gifts at any time before Christmas Day that the purchaser desired.

The accompanying photographs show the billboard advertising the holiday sales, as well as the interior decorations of the Electric Shop and of a display window in one of the branch offices. On the rear wall of the latter was a reindeer's head made of white papier-mâché sprinkled with mica to represent snow. The eyes were made of glass and were illuminated by incandescent lamps inside of the reindeer's head. A thermostat arranged to turn the lamps on and off alternately caused the eyes to blink and attract attention to the articles displayed in the show window.

FIG. 3—WINDOW DISPLAY

Elaborate Electrical Christmas Displays at Boston

The possibilities of using electricity in outdoor Christmas display advertising are being realized to a greater extent at Boston, Mass., this season than ever before. Three of the larger department stores in the downtown district inaugurated the striking displays shown in the accompanying halftones on the first of the month, and these will be maintained until after Christmas in each case. All three displays are supplied with energy from the three-wire 110-220-volt direct-current underground mains of the Edison Electric Illuminating Company of Boston. Although within about five minutes' walk of one another, each display is invisible from the others and thus creates its own center of interest and tends to localize patronage.

Fig. 1 is a view of the display of Houghton & Dutton, a firm which has been a pioneer in the spectacular use of electricity in the holiday season at Boston and whose elaborate decorations have been illustrated in this paper prior to the present year. In this display Santa Claus appears to be dashing out of his castle into the snow. On the side are two symbolic groups representing peace and prosperity, while underneath four heroic-size figures supporting the piece represent the four corners of the globe and emphasize the universality of the Yuletide season. The installation includes a total of 4200 incandescent lamps ranging in size from 12 watts to 250 watts, the usual unit being rated at 20 watts. Flashers inside the store vary the coloring at the top of the bastions and elsewhere, and simulated icicles at the bottom glitter with realistic effect.

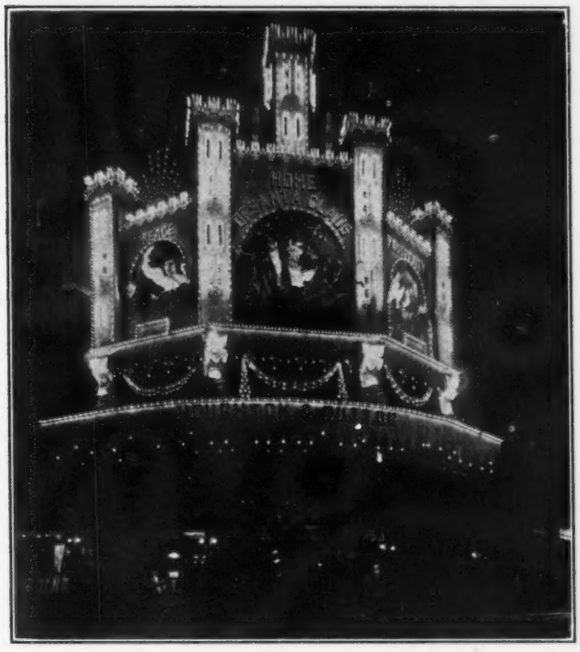


FIG. 1—SANTA CLAUS AND HIS REINDEER

The display of the Gilchrist Company (Fig. 2) shows a huge Christmas fireside scene with a head of "Old Father Christmas" 6 ft. in height over the mantel, other features being ornamental columns, symbolic representations of celestial heralds, children of the earth riding forth on reindeer, Christmas bells, and, 50 ft. above the street, the "Star of Bethlehem," composed of 186 20-watt lamps. The display as a whole includes 2000 20-watt lamps, 100 8-cp candelabra lamps, 100 100-watt tungsten lamps and two 750-watt gas-filled lamps, the last-named being in upper bells flanking the main display. Red and green lamps of the 20-watt

FIG. 2—A CHRISTMAS FIRESIDE

size produce the so-called "icicle effect," and the open fire is simulated by 20-watt amber-colored candelabra lamps with a background of 100-watt units.

Reindeer Give Place to Motor Car

At the store of the W. & A. Bacon Company (Fig. 3) a noteworthy display has been placed in operation showing the patron saint of the season seated in a flying automobile laden with gifts and good cheer with a large Christmas bell in festoons above. Twenty-watt lamps are used throughout, there being 1875 in the automobile alone and 200 in the bell and streamers. The automobile is 36 ft. long and 24 ft. high, and with the upper streamers and bell extends from the fifth to the second floor on the Washington Street façade of the building. The first two displays named were wired by Haley & Schaefer, Boston, the Bacon installation being made by employees of the house.

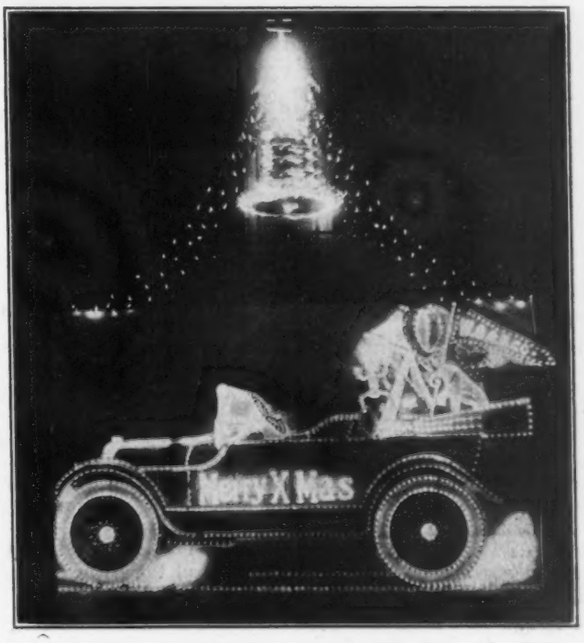


FIG. 3—A MODERN SANTA CLAUS

Industrial and Financial News

Public Utility, Commercial, Corporate and Trade Developments—The Electrical Material and Security Markets

Rebuilding Edison Plant.—The work of reconstruction of the parts of the plant of Thomas A. Edison, Inc., which were damaged by fire on Dec. 9 is progressing rapidly. Forces of men are engaged night and day and the plans for development of the new parts of the damaged structures are well under way.

Apparatus for Softening, Weighing and Filtering Water.—The Kennicott Company, Chicago Heights, Ill., manufacturer of apparatus for softening, filtering and weighing water, states that among the interesting power installations that it has made is that for the Mississippi River Power Company at Keokuk, Ia., which consists of a battery of filters which has a rated output of 60,000 gal. of water per hour.

Battery, Lamp and Telegraph Instrument Export Trade Increases.—The official figures for the October exports show that, with the exception of the battery, lamp and telegraph instrument trade, there was a lessened export trade for electrical apparatus in comparison with the previous year. The total value of electrical exports in October, 1914, was $1,494,792, as compared with $2,516,415 in October of the previous year.

Motor Manufacturer's Plant Slightly Damaged by Fire.—Two buildings in the foundry plant of the Robbins & Myers Company, Springfield, Ohio, were recently damaged by fire. Arrangements have been made with other foundries to continue the work carried on by the Robbins & Myers Company until the buildings are replaced, and the company's business will be neither hindered nor delayed. Work has already been begun to rebuild the property lost.

Low-Priced Electric Toasters Selling Well.—A toaster manufactured by the P. J. Electric Heating Company, 332 South LaSalle Street, Chicago, Ill., which was described in the *Electrical World* of Oct. 24, page 830, has met with considerable success. The toaster is a low-priced device, and Mr. P. J. Whiteside of the above company declares that the sales have been enormous. A large number of foreign orders have also been received. The P. J. company is working on other cooking devices, including electric ranges, which it expects to place on the market next spring.

Ball-Bearing Company Busy.—Weekly shipments are being received by the S K F Ball Bearing Company, 50 Church Street, New York, from its factory in Gothenburg, Sweden. The company's business in this country is very good. A large supply of ball bearings is being kept on hand, the company reports, in anticipation of a great amount of future business. The S K F bearings are especially meeting with favor for electric motors and generators, mine locomotives, textile and paper-making machinery, etc. Recently, they have been adapted for use with steel railroad cars.

Switchboard Business Picking Up.—On account of the depression in the building industry in and about New York City this fall, the Empire Engineering & Supply Company, 227 Fulton Street, New York, manufacturer of switchboards, reports that its business has not been very good; but since Dec. 1 the company has noted an improvement, and the prospects for the future are much better than they were two months ago. The above company is also making a number of electrical devices, among these being a recently developed automatic time switch and an attachment for pull sockets which lifts the chain and takes the strain off the socket.

Demand for Electric Toys.—The Lionel Manufacturing Company, 48 East Twenty-first street, New York, reports that it is selling a large number of its electrically operated toys this season. Popular among these are the miniature trains and automobiles. Locomotives are faithfully modeled after the patterns of passenger and freight engines in general use, as are also the cars and other accessories. In this way the devices have considerable educational value. The toys can be operated by batteries or they may be placed on regular lighting circuits when suitable transformers are provided. Besides the demand for electrically driven toys during the Christmas season, many stores use them, especially the trains, for display purposes throughout the year. The above company makes its own toys, its factory being at Newark, N. J.

Importers of Electrical Devices Doing Well.—Considering the adverse conditions brought about by the European war, the Importer Sales Company, 19 East Twenty-first Street, reports that its business is quite good. This company has an agency in Berlin, Germany, and it imports a number of electrical devices. Shipments have recently been received via neutral countries, but they have necessarily been irregular. On account of the difficulty of receiving Christmas lighting outfits, the above concern is manufacturing two sets of its own this year, one set being operated on batteries and the other on an ordinary lighting circuit. Among the devices of interest which this company is importing is an instantaneous water heater, a so-called electric candle, an electric house lamp and a recently developed electrically illuminated clock.

Christmas Selling Campaign.—An extensive selling campaign for the holiday season has been inaugurated by the Westinghouse Electric & Manufacturing Company, Pittsburgh, Pa. The company is sending to the dealers posters, street-car cards, mailing letters and leaflets on any of which the name of a dealer can be printed if desired. The posters are attractively lithographed in six colors. Wreaths and placards are provided for window displays. The first page of the mailing letter is in the form of a letter, the dealer's business name and address going in the panel below a Christmas sketch. At the bottom of the letter space is provided for the personal signature of the dealer. The inside pages contain information on various electric devices suitable for Christmas gifts. The envelopes furnished with these mailing letters are blank and of good stock, thereby giving the mail a personal touch. The advertising leaflet contains information for the dealer and explains how he may obtain the advertising literature which the Westinghouse company is sending out.

New York Safety Show.—The second annual Exposition of Safety and Sanitation was held at New York Dec. 12-19, under the auspices of the American Museum of Safety. A number of the displays were of electrical interest, and showed many devices for the safeguarding of life not only in industrial occupations but in the home and on public thoroughfares as well. The New York Edison Company's booth contained appliances which the company is using to insure safety to its employees and to the public, including protected switching apparatus, a model tool cart and a danger flag, which is always unfurled, for open manholes. A completely equipped freight elevator was a feature of the Otis Elevator Company's exhibit. The exhibition of various types of fire alarms shown in the booth of the fire department of the city of New York also attracted considerable interest. Among the railroads, the Union Pacific, the Southern Pacific, the New York Central & Hudson River and the Brooklyn Rapid Transit were represented by complete exhibits. Other companies having exhibits were the Metropolitan Engineering Company, Brooklyn, N. Y.; the B. F. Sturtevant Company, Hyde Park, Mass., and the American Model & Instrument Company, Worcester, Mass.

Corporate and Financial

Ohio & Western Utilities Bonds.—P. W. Brooks & Company, of New York, are offering $625,000 Ohio & Western Utilities Company first lien collateral trust 5 per cent and 6 per cent sinking-fund gold bonds, dated Nov. 16, 1914, and due Aug. 1, 1929.

Public Service Electric Company Sells Stock.—The Public Service Electric Company of Newark, N. J., has sold to the parent company, the Public Service Corporation of New Jersey, $2,000,000 of stock for cash at par, the proceeds to be used for construction and other corporate purposes.

Cities Service Company.—The Cities Service Company, in most of the cities in which it operates, is back to normal or nearly so, according to a statement by Mr. H. L. Doherty, president of the company. No immediate change is contemplated in the policy of deferring dividends, although the matter is under constant consideration.

Olean Electric Light & Power Bonds.—The Olean Electric Light & Power Company was authorized by the New York Commission, Second District, to issue $7,200 6 per cent thirty-year first and refunding mortgage bonds at not less than 80, to aid in meeting certain bills and accounts payable, not properly chargeable to operating expense or income.

Bond and Stock Authorization.—The Railroad Commission of California has authorized the San Diego Consolidated Gas & Electric Company to issue $250,000 of 6 per cent debenture bonds, due on Dec. 1, 1922, at not less than 93 and interest, and $240,000 of common stock at not less than par. The proceeds are to be used for refunding obligations of $472,296.

Pennsylvania Water & Power Bond Offering.—Messrs. Jackson & Curtis, of New York, are offering at 89 and interest a block of Pennsylvania Water & Power Company first mortgage 5 per cent sinking-fund gold bonds, dated Jan. 27, 1910, and due Jan. 1, 1940. This block of bonds was issued to reimburse the treasury for moneys expended out of income on recent extensions.

Wisconsin-Minnesota Light & Power Stock.—The Wisconsin-Minnesota Light & Power Company's stock recently authorized by the Michigan Railroad Commission has been used in the acquisition of several properties owned by the American Public Utilities Company. The transaction was merely an exchange of stock and getting several of the company's subsidiaries into one operating unit.

San Diego (Cal.) Company to Issue Bonds and Common Stock.—The California Railroad Commission has authorized the San Diego (Cal.) Consolidated Gas & Electric Company, a utility managed by H. M. Byllesby & Company, to issue $240,000 in common stock and $250,000 6 per cent debenture bonds, payable Dec. 1, 1922. The bonds are to be sold at not less than 93 and the stock at not less than par value.

Scranton Electric Company Bonds.—Harris, Forbes & Company, of New York, are offering an additional block of escrow bonds of the Scranton Electric Company. These bonds are first and refunding (non-first) mortgage 5 per cent gold bonds dated July 1, 1907, and due July 1, 1937. The earnings statement for the year ended Oct. 31, 1914, shows the net earnings to be approximately three times the bond interest.

International Power Adjudged Insolvent.—On Dec. 10 Chancellor Walker of the Court of Chancery of New Jersey filed an opinion deciding that the International Power Company of New Jersey was insolvent and that a receiver should be appointed and an injunction issued against the company restraining it from further business. The decision grew out of the charges of Mr. Henry W. Bull, of New York, chairman of the minority protective committee. The company has appealed from the decision to the Court of Errors.

Northern New York Utilities Authorized to Issue Securities.—The Public Service Commission of the Second District of New York has authorized the Northern New York Utilities, Inc., to issue securities amounting to $310,000, consisting of $200,000 of 5 per cent fifty-year first mortgage bonds, to be sold at not less than 90, $80,000 of cumulative 7 per cent preferred stock, and $50,000 of common stock. The proceeds are to be used for the purchase of the Carthage Electric Light & Power Company together with its obligations.

Worcester Electric Light Company to Issue Stock.—The Worcester (Mass.) Electric Light Company has been granted authority to issue 1000 shares of additional stock at $200 per share to cancel notes issued and to meet the cost of enlargements of plant and additions to the distributing system.

Northern California Power Authorized to Issue Stock.—The application of the Northern California Power Company, Consolidated, to issue 5000 shares of 6 per cent cumulative preferred stock at 80 was approved by the California commission. The proceeds are to reimburse the treasury for $225,000 expended for capital account and to provide $175,000 for extension and betterments. The company was to have its properties appraised before Dec. 1, and if any deficiency was found to exist between the sum of the obligations and the preferred stock, on the one hand, and the value of the property, on the other, the company may be ordered to assess the stockholders to make up the deficiency. This precaution is to protect the preferred stock.

Rochester Company to Issue Bonds.—The Rochester Railway & Light Company was authorized by the New York Commission, Second District, to issue $250,000 of 5 per cent fifty-year consolidated trust mortgage bonds, to refund a like amount of underlying bonds of the Brush Electric Light Company maturing on Jan. 15, 1915. The new bonds are to be sold at not less than 95. Should holders of the underlying bonds not be willing to exchange for the new bonds at not less than 95, permission is given to the company to enter into an agreement with such bondholders whereby an extension of the time for payment of the principal may be obtained for one year at an increase from 5 to 6 per cent interest during that time on the old bonds.

Georgia Railway & Electric Bonds Sold.—Charles C. Harrison, Jr., & Company, of Chicago, recently purchased and disposed of $16,000 Georgia Railway & Electric Company refunding and improvement mortgage sinking fund 5 per cent gold bonds. The bonds were offered for 93.5. The company is leased under a 999-year contract, effective January, 1912, by the Georgia Railway & Power Company, which company assumes under the lease the railway and electric company's fixed charges, the 5 per cent preferred-stock dividends and the 8 per cent common-stock dividends. The refunding and improvement mortgage 5 per cent bonds are secured by a general lien on all property of the company, subject to $10,444,000 prior liens. There was a sale of these bonds Dec. 4 at 95 and interest.

Southern California Edison to Sell Bonds.—The Railroad Commission of California has issued a supplemental order authorizing the Southern California Edison Company, of Los Angeles, to sell $134,000 of its 6 per cent bonds at not less than 86. These are part of a previous issue amounting to $2,500,000 which the company was authorized to sell at not less than 87½. The commission has also authorized the company to issue $784,000 of 5 per cent bonds; $266,000 may be issued at once, provided the company receives not less than 86 and interest. The proceeds will be used in paying promissory notes of $250,000. The remaining $518,000 bonds shall not be issued until the commission has made a further order specifying the minimum price of sale and the specific purposes to which the proceeds shall be applied

Columbus Companies to Vote for Consolidation.—On Jan. 7, 1915, at the annual meeting, the stockholders of the Columbus (Ohio) Light, Heat & Power Company will vote upon the question of consolidation with the Columbus Railway, Power & Light Company. Already 75 per cent of the outstanding shares have been deposited in accordance with the proposition made by the larger company. Stockholders of the Columbus Light, Heat & Power Company will transfer their holdings on the terms the Columbus Edison Company stockholders received and they will get series A preferred stock of the Columbus Railway, Power & Light Company for their preferred and series B preferred for their common stock. It is thought that the Columbus Railway, Power & Light Company will proceed with the reorganization of its finances as soon as this consolidation is completed. Outstanding bonds of the various companies will be refunded.

Boston Edison Shareholders.—The Edison Illuminating Company of Boston has 4900 shareholders, with an average holding of forty-two shares. Fifteen shareholders have 1000 shares or over, they being the estates of George Peabody, Gordon McKay, S. B. Cabot, G. P. Upham, W. P. Mason and Quincy A. Shaw; Messrs. George R. White, George A. Gardner, William E. Rice, George A. Peabody, E. Pierson Beebe and J. Otis Wardwell, and Kidder Peabody & Company, the trustees of Harvard College and the Boston Insurance Company.

Southern California Edison's Expansion.—Assistant General Manager R. H. Ballard, of the Southern California Edison Company, Los Angeles, states that the year's expenditure for growth in demand will be $1,762,000. The year's extensions have been made at the demand of an increasing population and not in new fields where a demand would have to be created. According to Mr. Ballard, the expenditure includes no large items but only small ones. The extension field covers the counties of Kern, Santa Barbara, Ventura, Los Angeles, Orange, Riverside and San Bernardino. The bulk of the expenditures was made in Los Angeles.

Wisconsin Railway, Light & Power Company's Annual Report.—The Wisconsin Railway, Light & Power Company has rendered its first report, covering the time from organization on Feb. 10, 1913, to June 30, 1914. The report shows the operations for the year ended June 30, 1914, and also for the period Feb. 10, 1913. to June 30, 1913. For the twelve months ended June 30, 1914, gross earnings were $385,947, from which were deducted operating expenses and taxes amounting to $248,116, leaving as net earnings $137,-831. Interest amounted to $111,000, leaving a balance of $26,831. The company has made many improvements to its properties and undertaken considerable new construction, the total cost of which was $168,194. Mr. Clement C. Smith, president of the company, stated that while the street-railway earnings had fallen off materially, owing to the European war, the electric light and power earnings had suffered no loss to Aug. 1 and but a very small loss since then. Mr. Smith stated: "The company has used every endeavor to reduce expenses to meet the loss in earnings, and fortunately the completion of numerous improvements to the property has assisted in reducing the operating costs so that the net earnings still show a slight gain over last year."

American Gas & Electric Declares Extra Dividend.—The American Gas & Electric Company has declared an extra dividend of 2 per cent on the common stock. The dividend has been declared out of the surplus net earnings of the company and is payable in common stock on Jan. 2, 1915. The regular quarterly dividends of 1½ per cent on the preferred stock and 2 per cent on the common stock were declared. At the office of the company the following statement was made in reference to the extra dividend: "It has been the policy of the American Gas & Electric Company to disburse in common-stock dividends a reasonable part of its surplus earnings over and above the usual 8 per cent cash dividends, in line with which policy the company has declared an extra 2 per cent stock dividend, payable Jan. 2, 1915. The company also made an extra 2 per cent stock dividend July 1, 1914. The company attributes its satisfactory condition to its steadfast policy of making actual physical value the principal consideration when acquiring properties instead of capitalized earnings of the property acquired. This, combined with an efficient organization giving closest possible application to the affairs of the company, has made possible the furnishing of the best service the state of the art will permit at lowest possible rates, and resulted in good standing with the communities served. The earnings of the company have shown a very satisfactory increase over the previous year, due to the fact that the properties controlled by it are in various sections of the East and Middle West in which are established industries of an extremely diversified character. A large portion of the revenue derived by the local companies is from the sale of motor service, and while some lines of business served have been affected adversely, others have prospered, so that material increases in gross revenue are reported from practically every company of the American Gas & Electric organization."

LIGHTING UTILITIES MAKE RECORD

After Two Months of War Depression Central Stations of Country Show a 7 Per Cent Growth

The electric utility companies of the United States have since the war began made for themselves an enviable record. It will be noted from the accompanying table that the companies in September, the second month of the war, showed an increase in both gross income and energy output of 7 per cent. Moreover, the decrease in the percentage rate of growth for gross income has been exceedingly small. On the other hand, the decrease in output growth rate percentage has been appreciable. This is explained by the fact that so many companies in the past year have made tremendous efforts toward increasing the domestic consumption of energy. One large company operating in the Central States stated that while the domestic consumers were using 10 per cent less energy for lighting purposes since the war began, the number of new customers was increasing to such an extent that the company was still showing large gains over the preceding year. One large holding company which controls properties in the Northwest, Southeast and Middle West stated that the efforts of the salesmen were being largely directed toward securing a greater

CENTRAL-STATION OPERATION STATISTICS OVER A THREE-MONTH PERIOD

	Income Derived from Sale of Energy			Energy Output in Kw-hr		
	1914	1913	Per Cent Increase	1914	1913	Per Cent Increase
July (68 per cent of industry)	$14,086,822	$12,970,325	8.5	803,848,850	649,720,026	23.8
August (70 per cent of industry)	15,298,226	14,200,649	7.8	778,109,565	718,274,456	8.2
September (70 per cent of industry)	15,708,695	14,694,205	7.0	782,450,2	733,754,420	6.8

number of domestic customers. This field is so far from the saturation point in many sections that the amount of new business which can be derived from it is of startling proportions. The companies have now come to realize that in order to keep their earnings up they must have on their lines a load which is very little affected by business depression.

The motor load is at times uncertain. While the large motor users ordinarily make a contract to use a certain minimum amount of energy, the generating companies must be in a position to furnish energy for the maximum demand of that company. Often in case of very large contracts this means the installation of additional machinery and apparatus, on which the generating company has to pay the annual fixed charges of depreciation, taxes and maintenance. These fixed charges go on irrespective of whether the demand is normal or not. When these fixed charges plus the operating charges are deducted from the gross earnings the result may not be entirely satisfactory. The companies, therefore, are now looking for a more stable way of reducing their operating charges, so that in times of depression they can still keep up a large amount of their load and yet not have a disproportional amount of fixed charges. It is undoubtedly for this reason that the companies have turned to the domestic users of energy as their field of growth. The results of their efforts can plainly be seen from the accompanying table.

While the figures in the table are for most purposes comparable, it must nevertheless be remembered that the same companies are not contained in each month's figures. There are some companies in the August and September figures which are not included in the July figures, and, unfortunately, the reverse is true. Our figures for October are so far rather incomplete. They include a number of companies not represented in the figures for the preceding months. The percentage growth in income was 7.4 and in

output 4.5. It will be noted that the rate of growth for income was better than for the month of September, while the output growth was not quite so good. In view of what has been said above, this was to be entirely expected. As soon as the industries of the country become stable and start to work on new orders the percentage rate of growth in output will once more show a growth by leaps and bounds.

During the month of October the companies which felt the strain the most were those operating in our largest cities. Those companies which were doing for the most part a lighting business and little or no motor business were showing large rates of growth, in some cases over 20 per cent. The recent opening of the stock exchanges throughout the country will undoubtedly have its beneficial effect upon the manufacturers so that the amount of energy used in factories ought to increase rapidly.

Business Notes

The Marion County Electric Company, Knoxville, Ia., is now the name of the concern which has been known as the Knoxville Electric Company.

The Yale & Towne Manufacturing Company.—M. C. Maxwell, for the past seven years head of the department of applied mechanics at Pratt Institute, Brooklyn, has been appointed superintendent of power and plant of the Yale & Towne Manufacturing Company, Stamford, Conn.

The American Manufacturers' Agency, Inc., 111 Monroe Street, Chicago, of which Mr. William H. McKinlock is president, has taken the Western and Northwestern agency for the switch boxes, plates, conduit boxes and cabinets made by the Federal Electric Company, of Pittsburgh, Pa.

New Industrial Companies

The Utica Power Saving Company, of Utica, N. Y., has been organized by Stanley E. Gilbert, Thomas F. Conboy and Spencer Kellogg, of Utica, N. Y.

The Maher Manufacturing Company, of Libertyville, Ill., has been chartered with a capital stock of $50,000 by N. L. Maher, L. W. Maher and E. C. Armitage. The company purposes to manufacture lighting fixtures and automobile accessories.

The Empire Lighting Fixture Company, of New York, N. Y., has been incorporated with a capital stock of $25,000 to manufacture lighting fixtures and appliances, etc. The incorporators are L. Schaeffer, the Bronx; I. B. Ansorge and P. I. Ansorge, of Brooklyn, N. Y.

The Nichols Electric Company, of New York, N. Y., has been incorporated by N. Macaluso and J. Corami, of New York, N. Y., and J. Giaimo, of Paterson, N. J. The company is capitalized at $25,000 and intends to manufacture wireless and other electrical apparatus.

The Allied Electric Company has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $750,000 for the purpose of manufacturing electric fans, etc. The incorporators are W. M. McEwen, V. P. Arnold and L. Klein, of Chicago, Ill.

Gaites, Peace & Company, of Brooklyn, has been chartered with a capital stock of $15,000 to manufacture gas and electric fixtures. The incorporators are C. F. Peace, 1193 Lincoln Place, Brooklyn; E. H. Nostrand, Jamaica, and G. M. Hammond, Brooklyn.

The Kentucky Revivo Battery Company, of Louisville, Ky., has been chartered with a capital stock of $200,000 for the purpose of manufacturing a patented electrical device. The incorporators are H. W. Embry, Sixteenth and Aebegust Streets, Louisville, Ky.; O. M. Billings and Henry Burnett.

The Southern Supply Company has filed articles of incorporation under the laws of the State of Maine with a capital stock of $100,000 for the purpose of manufacturing, exporting, importing and dealing in electrical appliances, fixtures and supplies. A. F. Jones is president and T. L. Croteau treasurer, both of Portland, Ore.

The Tollometer Sales Company has filed articles of incorporation under the laws of the State of Delaware. The company is capitalized at $100,000 and purposes to manufacture and sell tollometers and telephone appliances. The incorporators are F. R. Hansell, of Philadelphia, Pa.; G. H. B. Martin and S. C. Seymour, of Camden, N. J.

The Safety Signal Company, of New York, N. Y., has been incorporated by Arthur S. Dennen and Stanley C. Fowler. The company is capitalized at $200,000 and intends to manufacture automobiles, general machinery, electrical devices, signals and safety devices for automobiles, etc. Arthur W. Dennen, 19 Cedar Street, New York, N. Y., is attorney.

The Electro-Chemical Supply & Engineering Company has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $100,000 for the purpose of manufacturing machinery used in connection with the electric chemical industry. The incorporators are Bert. R. Spencer and A. R. Yeakle, of Washington, D. C., and Joseph A. Burkhart, of Maryland.

The Marsden Electric Company, of Rutland, Vt., has been incorporated with a capital stock of $25,000 by Arthur B. Marsden and R. L. Marsden, both of Manchester Center, and L. C. Davis, of Manchester Depot, Vt. The company intends to deal in electrical and gas fixtures and to do a general electrical contracting business, including building and installing electric and gas plants.

The Electric Supply Company, of Worcester, Mass., has been incorporated by interests identified with the C. C. Coghlin Electric Company, of Worcester, for the purpose of dealing in electrical, gas and automobile accessories. The place of business will be located at 294 Main Street, Worcester. Charles C. Coghlin is president and Edward F. Coghlin treasurer.

Trade Publications

Insulating Varnishes.—"Insulating Varnishes and Compounds" is the subject of a booklet that is being sent out by the Sterling Varnish Company, Pittsburgh, Pa.

Fuses.—The Delta-Star Electric Company, 615 West Jackson Boulevard, Chicago, Ill., is sending out a placard containing list prices of several types of fuses.

Showcase Lighting.—Bulletin No. 22 recently issued by the National Lamp Works of the General Electric Company, Cleveland, Ohio, is entitled "Showcase Lighting."

Small Generating Set.—"Steam-Engine-Driven Generating Sets" is the subject of Bulletin No. 42,300, recently published by the General Electric Company, Schenectady, N. Y.

Conduit.—The Western Conduit Company, Youngstown, Ohio, has issued a booklet containing illustrations of representative buildings in San Francisco in which its "Buckeye" conduit is used.

Vacuum-Cup Washing Machine.—A motor-driven washing machine equipped with so-called vacuum cups is described in a bulletin issued by the Beebe Sales Company, Minneapolis, Minn.

Magnetic Switches.—Several recently developed magnetic switches are described and illustrated in a booklet recently issued by the Cutler-Hammer Manufacturing Company, Milwaukee, Wis.

Asbestos-Covered Metal.—Bulletin No. 54 sent out by the Asbestos Protected Metal Company, Beaver Falls, Pa., is an attractively illustrated catalog describing asbestos-covered steel for roofing and for walls.

Incandescent Lamps.—The Franklin Electric Manufacturing Company, Hartford, Conn., is sending out a folder entitled "Shake Hands with the Franklin Man," which calls attention to features of its tungsten and carbon lamps.

Recording Gages and Thermometers.—Bulletin No. 86 issued by the Industrial Instrument Company, Foxboro, Mass., contains information on differential recording gages and orifice meters for measuring the flow of gas, and Bulletin No. 91 sent out by the same company describes and illustrates recording and indicating-dial-type thermometers.

Lighting System.—"Scientific Illumination" is the subject of a brochure issued by the General Electric Company, London, Eng.

Dimming Devices.—A large illustrated folder containing information on a dimming device for incandescent lamps is being sent out by the Wirt Company, Philadelphia, Pa.

Wiring Devices.—A number of wiring devices are illustrated and listed in Bulletin No. 400 recently published by the Fargo Manufacturing Company, Poughkeepsie, N. Y.

Portable Electric Tools.—Several types of electric drills, grinders, buffers, etc., are described in Bulletin No. 400 just issued by the Stow Manufacturing Company, Binghamton, N. Y.

Single-Phase Motors.—Bulletin No. 106 just issued by the Wagner Electric Manufacturing Company, St. Louis, Mo., contains information on several horizontal and vertical single-phase motors.

Alternating-Current Motors.—The Robbins & Myers Company, Springfield, Ohio, has issued a leaflet designated as No. 1031 which contains information on small alternating-current polyphase motors.

Steel Transmission-Line Structures.—The Archbold-Brady Company, Syracuse, N. Y., has issued a catalog containing information on a number of different types of steel transmission structures and catenary bridges.

Turbo-Generator Sets.—Small turbo-generator sets ranging in rating from 7 kw to 300 kw are described and illustrated in Bulletin No. 42,010 recently published by the General Electric Company, Schenectady, N. Y.

Personal Mention

Mr. W. P. Graham, Dallas, Tex., has been elected secretary of the Electrical Contractors' Association of Texas.

Mr. H. O. Fiske, of Peterboro, Ont., has been appointed manager for the Peterboro public utilities, succeeding Mr. C. L. Howse.

Mr. G. B. Frayer has resigned as Chicago sales manager of the Edison Storage Battery Company to operate a ranch near Portland, Ore.

Mr. Charles H. Dudley, formerly of the Toronto Hydro-Electric System, has accepted the position of sales manager of the Volt Electric Company, Ltd., Toronto.

Mr. L. C. Gidney, superintendent of the municipal electric-light plant at Rutherfordton, N. C., will have charge of the city lighting plant at High Point, N. C., afer Jan. 1, 1915.

Mr. J. E. Cowles, superintendent of the electrical department of the Southwestern Gas & Electric Company, Shreveport, La., has been elected president of the Shreveport Advertising Club.

Mr. Elmer A. Clark, claim agent of the Idaho Railway, Light & Power Company, Boise, Idaho, has accepted a similar position with the Utah Power & Light Company, Salt Lake City, Utah.

Mr. Homer G. Knoderer, who has been sales manager for the Western Electric Company at Cleveland, Ohio, has been appointed general sales manager of the Adams-Bagnall Electric Company, Cleveland.

Mr. Norman B. Hickox, former treasurer and manager of the Greenwood Advertising Company, Knoxville, Tenn., has accepted a position in the supply department of the Thomas Cusack Company, Chicago, Ill.

Mr. George S. Baker has been appointed general manager of the Chattanooga & Tennessee River Power Company, Chattanooga, Tenn., as successor to Mr. Byron T. Burt, who resigned to go to Buenos Aires as manager of the South American Trading Company.

Mr. John H. Roemer, chairman of the Wisconsin Railroad Commission, Madison, has resigned, effective Feb. 1, 1915, to join the organization of H. M. Byllesby & Company, Chicago, in charge of the latter's legal department. Mr. Roemer has served on the Wisconsin commission since 1907, when its duties were enlarged to include the regulation of other utilities than steam railroads. Four years ago he was appointed chairman of the commission. Prior to his connection with the commission at Madison Mr. Roemer was for fifteen years engaged in the practice of law at Milwaukee.

Mr. John A. Britton, vice-president and general manager of the Pacific Gas & Electric Company, was the guest of honor at a dinner of the McGraw Publishing Company, Inc., held at the Engineers' Club, New York, on Dec. 16 and attended by the executives and others connected with the various publications of the company.

Mr. H. C. Hopson, who has been in charge for six years of all the financial and accounting examinations relative to rates, reorganizations and capitalization for the New York Public Service Commission, Second District, has opened an office as counsel and attorney-at-law in Washington. While Mr. Hopson is with the New York commission no matters affecting New York public service corporations can be taken.

Mr. Byron T. Burt has resigned as general manager of the Chattanooga & Tennessee River Power Company, Chattanooga, Tenn., effective Jan. 1. Mr. Burt will leave this country to go to Buenos Aires early in 1915 as manager of the South American Trading Company. He was formerly manager of the old Chattanooga Electric Company until its consolidation with the Chattanooga Railway & Light Company. When the Chattanooga & Tennessee River Power Company was organized to construct the hydroelectric plant at Hale's Bar on the Tennessee River he was made general manager. Mr. Burt will be succeeded by Mr. George S. Baker, who has been auditor of the company since it opened offices in Chattanooga.

Mr. Harry W. Alexander, publicity and sales manager of the Federal Light & Traction Company, New York, has resigned his position to become manager of the editorial and advertising section of the Society for Electrical Development. He will begin his new duties Jan. 1, 1915. Mr. Alexander has had varied experiences in publicity and sales work. He was born in Los Angeles July 17, 1888. In 1909 he entered the field of metropolitan journalism, starting with the Chicago *Inter Ocean*, where he successively handled the departments of labor, finance, special assignments, politics and public utilities. At one time he held one of the editorial staff positions. Finding public utilities to his liking, early in 1911 he became associated with the Federal Light & Traction Company's operating department, resigning a year later to go with the construction forces of the Kansas City, Clay County & St. Joseph Railway, an electric line then building between Kansas City and St. Joseph, Mo. Returning late in 1912 to the Federal company, he became connected with the sales department and in May, 1913, became publicity manager. In this capacity he was first engaged to work toward effecting better public relations between the subsidiary companies and the local press and public. Later he received charge of the sales department, which he handled in conjunction with the publicity department, preparing all of the advertising copy and handling the appliance sales campaigns.

Obituary

Charles W. Macy, president of the former Hudson (N. Y.) Electric Light & Power Company, died at his home in that city Dec. 3.

Col. Edward Samuel Meier, one of the most eminent mechanical engineers in the United States, a veteran of the Civil War and a past-president of the American Society of Mechanical Engineers, died in New York on Dec. 14.

William H. Coughlin, formerly superintendent of the Worcester (Mass.) Electric Light Company, died in Philadelphia Dec. 7. Mr. Coughlin was superintendent of the electric light company at Worcester from the time the company was established in 1883 until 1911.

William Chandler, vice-president and general manager of the Edison Sault Electric Company and president of the Chippewa Edison Company, of Sault Ste. Marie, Mich., died Dec. 10. Mr. Chandler was identified with the city's largest industries and was a member of the State Legislature of Michigan from 1899 to 1901. He was vice-president of the Association of Edison Illuminating Companies for many years. A widow and a son survive him.

Construction

New England

MANCHESTER, N. H.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Jan. 15 for the installation of an electric freight elevator, etc., in the United States post office and court house at Manchester. For details see proposal columns. O. Wenderoth is supervising architect.

MARBLEHEAD, MASS.—Plans are being considered by the municipal electric light commissioners to furnish electricity from the municipal plant to operate the water-works system, which is now being purchased from a private company.

NEEDHAM, MASS.—The J. A. Beverly Co., 19 Essex Street, Haverhill, Mass., has secured the contract for electrical work on the four buildings of the Needham Tire Co. being erected near the Charles River Station, Needham. The contract covers the installation of necessary equipment for lighting and power.

PASCOAG, R. I.—Because of its inability to fulfil its obligations to the Pascoag Fire district, as contained in a contract made last May, whereby it was to furnish electricity to the fire district for a period of 20 years, the Rhode Island Pwr. Transmission Co. (the Rhode Island branch of the Connecticut River Pwr. Co.) has assigned its rights, privileges and contracts in Burrillville to the Blackstone Valley Gas & El. Co., of Pawtucket, which is controlled by the Stone & Webster Management Association, Boston, Mass. The latter company will carry out the contract with the fire district and will furnish energy in Pascoag.

WALLUM LAKE, R. I.—Bids will be received at the office of the Board of Control and Supply, Providence, R. I., until Dec. 24, for installing electrical apparatus in the children's ward of the State Sanitarium at Wallum Lake. Plans and specifications may be obtained of Walter F. Fontaine, Woonsocket, or at the office of the Board of Control and Supply, Providence. Gilbert R. Parker is secretary of board.

GROVE BEACH, CONN.—Among the improvements contemplated by the town next year is the installation of an electric-lighting system.

NEWTON, CONN.—Plans are being considered to light the streets of the town by electricity.

TORRINGTON, CONN.—Plans have been prepared by E. H. Waterbury for the construction of an addition (16 ft. by 42 ft.) to the plant of the Torrington El. Lt. Co. The plans also include the erection of a steel smokestack and the installation of two boilers.

Middle Atlantic

ALBANY, N. Y.—The Delaware & Hudson Co., of Albany, it is reported, has awarded the contract for the construction of a substation at Sheridan and Chapel Streets, Albany, to the Hunkin-Conkey Construction Co., at about $160,000. This station when completed will be used to transform energy from the Spier Falls plant for the local street railways.

BROOKLYN, N. Y.—Bids will be received by William Williams, commissioner Department of Water Supply, Gas and Electricity, until Dec. 29 for furnishing and maintaining electric lamps for lighting streets, parks and public places and furnishing electricity thereto and to public buildings, offices, places and structures, and for work in connection with electric-lighting equipment, during the year 1915. Blank forms of bid, proposals and contract can be obtained at Room 2324, Municipal Building, New York.

CANAJOHARIE, N. Y.—The Montgomery El. Lt. & Pwr. Co., of Canajoharie, is contemplating extending its transmission lines to Cherry Valley to furnish electrical service there.

NEW YORK, N. Y.—Bids will be received by William Williams, commissioner of Department of Water Supply, Gas and Electricity, Municipal Building, New York, until Dec. 26 for furnishing and maintaining electric lamps for lighting streets, parks and public places and furnishing electricity thereto and to public buildings, offices, places and structures, and for work in connection with electric equipment. Blank forms of bid, proposals and contract, including specifications, can be obtained at Room 2324, Municipal Building, New York, N. Y.

NEW YORK, N. Y.—Bids will be received by William Williams, commissioner of Department of Water Supply, Gas and Electricity, Municipal Building, New York, until Dec. 29 for furnishing and maintaining electric lamps for lighting streets, parks and public places and furnishing electricity thereto to public buildings, offices, places and structures, and for work in connection with electric-lighting equipment, during the year 1915. Blank forms of bids, proposals and contract, including specifications, can be obtained at Room 2324, Municipal Building, borough of Manhattan.

POUGHKEEPSIE, N. Y.—Plans are being considered by the merchants on Academy Street for installing new lamps on that thoroughfare from Main Street to Cannon Street.

ROCHESTER, N. Y.—The Board of Contract and Supply has awarded a contract for additional lamps in Church, Allen, Elizabeth and Andrew Streets and Plymouth Avenue North, and the contract for lighting 450 fire-alarm boxes, to the Rochester Ry. & Lt. Co.

ROCHESTER, N. Y.—Bids will be received at the office of the secretary of the Board of Education, Municipal Building, Rochester, until Dec. 21 for installing electric lamps in Franklin School, No. 6, on Montrose Street. Specifications may be obtained at the office of Edwin S. Gordon, architect. J. S. Mullan is secretary.

EMAUS, PA.—The contract for electrical work in the new school building being erected in Emaus has been awarded to the Allentown El. Construction & Supply Co., of Allentown.

HARRISBURG, PA.—Bids will be received at the office of the supervising architect, Treasury Department, Washington, D. C., until Dec. 30 for the removal of the present electric elevator and furnishing a new electric passenger elevator and a hydraulic freight lift in the United States post office and court house at Harrisburg, Pa., in accordance with drawings and specifications. O. Wenderoth is supervising architect.

POTTSVILLE, PA.—The City Council has granted the Edison El. Lt., Ht. & Pwr. Co. permission to erect high-tension lines along Palo Alto and through Norwegian Township. The company will supply electricity in Girardville and Ashland, and will doubtless later furnish energy in Gordon, Gilberton, Frackville and Mahonoy Plane.

RANDOLPH, PA.—The local electric-light plant, owned by Woodworth & Grace, is reported to have been purchased be G. W. Gerst, of New York, N. Y. The new owner, it is understood, will extend the service to surrounding towns.

SOUTH BETHLEHEM, PA.—Plans are being prepared for the erection of a new high school building in South Bethlehem, for which bonds to the amount of $185,000 have been authorized. The building, it is said, will have an extensive electrical equipment. D. J. McCarty is superintendent of schools.

BRIDGETON, N. J.—The City Council has entered into a contract with the Bridgeton El. Co. for lighting the streets of the city for a period of five years. The new contract provides for an ornamental lighting system in the business district and for many additional lamps.

TRENTON, N. J.—An investigation of the advisability of acquiring the Sanhican Creek for municipal power and lighting purposes has been recommended to the City Commission by Mayor Donnelly. He also asks that an engineer be employed to determine the possibilities of the development. It is estimated that in addition to lighting the city sufficient power could be developed to pump the city water supply.

BALTIMORE, MD.—Bids will be received by the Board of Awards of Baltimore City, office of the city registry, City Hall, Baltimore, until Dec. 30 for furnishing and erecting electric power equipment, including four 200-kva transformers, circuit-breakers and high-tension switchboard; all wiring and starters for connecting up various motors, and for furnishing two 200-hp motors and three 75-hp motors for the upper service pumping station, contract No. 31, Water Department. Plans and specifications may be obtained at the office of the water engineer, City Hall, Baltimore, for which a deposit of $5 will be required, to be refunded upon return of same. Robert L. Clemmitt is acting water engineer.

LOGAN, W. VA.—Contracts have been awarded by the Logan County Lt. & Pwr. Co. for the erection of its new power plant in Logan as follows: For construction of power house to C. W. McNulty, of Huntington, W. Va.; structural steel, Riverside Bridge Co., Martins Ferry, Ohio; concrete stack, General Concrete Construction Co., New York, N. Y.; electrical equipment complete, General Electric Co., Schenectady, N. Y.; boilers and superheaters, Edge Moor Iron Co., Edge Moor, Del.; condensers, boiler feed and auxiliary pumps, H. R. Worthington, Inc., Philadelphia, Pa.; stokers, Detroit, Stoker Co., Detroit, Mich.; coal-handling equipment, C. W. Hunt Co., New York, N. Y., and transmission wire, Aluminum Co. of America, Pittsburgh, Pa. About 60 miles of 44,000-volt transmission line will be erected. Contracts for the transmission line, power-plant piping, traveling crane and miscellaneous equipment will be awarded shortly. Francis R. Weller, Hibbs Building, Washington, D. C., is engineer. This company is controlled by the General Utilities & Operating Co., Baltimore, Md., of which J. C. M. Lucas is president.

SUMMERVILLE, W. VA.—The Summerville & Gauley River Improvement Co. is reported to be interested in a project to develop water-power. L. C. Williams, of Richwood, Va., is interested.

BALCONY FALLS, VA. (not a post office).—Cecil L. Reid, engineer, of Fredericksburg, Va., is reported to be interested in a project to build a dam across the James River in connection with a hydroelectric development.

RICHMOND, VA.—Preliminary steps have been taken by the Administrative Board toward the installation of ornamental lamps in Ginter Park, Fulton, on various streets in the heart of the city and in the South Side and for the extension of those on Broad Street. A resolution has been adopted authorizing the city electrician to furnish the board with an estimate of the cost of carrying out this improvement.

WASHINGTON, D. C.—Bids will be received at the Bureau of Yards and Docks, Navy Department, Washington, D. C., until Jan. 2 for an extension to the underground electric distribution system at the naval training station, Great Lakes, Ill. Plans and specifications may be obtained on application to the above bureau or to the commandant of the naval station named. H. R. Stanford is chief of bureau.

WASHINGTON, D. C.—Bids will be received at the Bureau of Supplies and Accounts, Navy Yard, Washington, D. C., until Dec. 29 for furnishing at the various navy yards and naval stations the following supplies: Washington, D. C., Schedule 7676—10,000 lb. phosphor copper in ingots. Bids will also be received at the same place until Jan. 5, 1915, as follows: Charleston, S. C., Schedule 7715—one 600-sq. ft. surface condenser; Schedule 7708—miscellaneous cotton-covered single-magnet wire. Norfolk, Va., Schedule 7708—150 water-tight bells and 12 water-tight buzzers. Brooklyn, N. Y., Schedule 7708—500 ft. telephone cable. Philadelphia, Pa., Schedule 7708—miscellaneous cotton and silk-covered magnet wire. Brooklyn, N. Y., Schedule 7714—eight trolley hoists for handling 14-in. shells. Newport, R. I., Schedule 7700—10,000 lb. seamless brass tubing, miscellaneous annealed seamless copper tubing. Charleston, S. C., Schedule 7715—179 cold-drawn seamless boiler tubes. Bids will also be received until Jan. 12, 1915, for furnishing one automobile ambulance at the navy yard at Puget Sound, Wash., as per Schedule 7698. Application for proposals should give the schedule desired by number.

WASHINGTON, D. C.—Foreign trade opportunities as announced by the Bureau of Foreign and Domestic Commerce in the Daily Consular and Trade Reports: No. 14,798—An American consular officer in Europe advises that a firm in his district desires to place orders with American manufacturers of gas pipes up to 8 in. in diameter, lathes, industrial mechanical appliances and instruments, rotary oil drills and implements, cotton, wool and rubber belting, pumps of all kinds, electrical heating apparatus, dynamos and motors of small power, oil motors, heating apparatus and ventilators, asbestos and vulcanized layers, wires and conduits. The firm would like to obtain exclusive agencies for certain of these lines. No. 14,777—A firm which is engaged in the construction business in the Far East advises an American consul that it wishes information relative to building material and engineering supplies. No. 14,782—An American consular officer advises that a railway company in the Far East is contemplating the installation of a system of block signals for a double-track railway, complete with telephone system. It is desired to obtain this equipment in America. No. 14,785—An American consular officer in the Far East advises that a railway company in his district is planning to install a new telephone system for a municipality. Firms interested in furnishing electrical supplies, etc., should send catalogs and price list. No. 14,774—An American consul in the United Kingdom reports that a firm of manufacturers of special metals and drawn wire in his district is desirous of communicating with manufacturers of electric incandescent lamps with a view of purchasing in considerable quantities. No. 14,776—An American consular officer in South America advises that an agent in his district desires to secure an exclusive agency for an

American engine similar to the German Otto engine. He desires catalogs containing full descriptive literature and illustrations. The agent is especially interested in a gasoline engine for industrial use, but will consider engines which consume crude oil. The catalogs and correspondence should be in Spanish, but may be in English. No. 14,757—A commission house in the Near East desires to be placed in communication with manufacturers of pumps, turbines and hydraulic machinery, oil and gasoline motors and tractors, cotton gins, agricultural, industrial and household tools, etc. The consul states that this firm is in a position to obtain large contracts. Further information may be obtained on application to the Bureau of Foreign and Domestic Commerce, Department of Commerce, Washington, D. C., or to the following branch offices: Room 409, United States Custom House, New York, N. Y.; 629 Federal Building, Chicago, Ill.; Association of Commerce Building, New Orleans, La.; 310 United States Custom House, San Francisco, Cal.; 521 Post Office Building, Atlanta, Ga.; 1207 Alaska Building, Seattle, Wash., and 752 Oliver Building, Boston, Mass.

North Central

MOUNT MORRIS, MICH.—At an election held recently the proposal to grant the Flint El. Co., of Flint, a franchise to supply electricity in Mount Morris was carried.

BOWLING GREEN, OHIO.—Bids will be received by D. C. Brown, of Napoleon, Ohio, secretary of the board of trustees of the Bowling Green State Normal College, Bowling Green, until Jan. 9 for furnishing material and construction of fireproof power station, stack, tunnel system, water supply and softening plant, electrical work, gasfitting, steam mains, pumps, etc., according to plans and specifications on file with the secretary of the board, Napoleon; also at the office of Victor Donahey, state auditor, Columbus, Ohio; Howard & Merriam, architects, 8 East Broad Street, Columbus, and H. B. Williams, president, Bowling Green, and at the Builders' Exchange in the following cities: Columbus, Toledo, Cleveland, Dayton and Cincinnati, Ohio. Bids will be received on the whole work or any part of the work.

COLUMBUS, OHIO.—Bids will be received by B. L. Bargar, director of public safety, City Hall, Columbus, Ohio, until Dec. 26 for furnishing high-grade rubber-insulated, lead-covered telephone cable as follows: 776 ft. carrying 50 twisted pairs; 1255 ft. carrying 10 twisted pairs; 705 ft. carrying 6 twisted pairs; 492 ft. carrying 5 twisted pairs; 1259 ft. carrying 4 twisted pairs, and 1000 ft. carrying 2 twisted pairs. All cable to be made in accordance with specifications which are on file in the office of the director of public safety.

FREMONT, OHIO—The County Commissioners have granted the Ohio Lt. & Pwr. Co. a franchise to erect and maintain transmission lines through Sandusky County. The company proposes to erect a high-tension line (33,000 volts) from its power house in Tiffin into Fremont, enabling the company to connect its power houses in Tiffin, Fremont and Fostoria.

NEW PHILADELPHIA, OHIO.—The County El. Co., of New Philadelphia, it is reported, has agreed to make a number of improvements to its plant here.

SANDUSKY, OHIO.—The City Council has awarded the Sandusky Gas & El. Co. a contract for the installation of an ornamental street-lighting system in the business district.

CARLISLE, KY.—The electric-light franchise recently drafted by the City Council has been purchased by the Carlisle El. Lt. & Pwr. Co.

HORSE CAVE, KY.—J. K. Scaggs and P. T. Vaughan have purchased control of the Reid Milling Co., which operates the local electric-lighting system. The business hereafter will be operated under the name of the Scaggs Milling Co.

LEXINGTON, KY.—The Lexington Utilities Co. has submitted plans to the Board of Commissioners for the maintenance of a proposed ornamental street-lighting system, consisting of 96 standards on Main Street, between Broadway and Walnut Street. Each standard is to carry two 300-watt type C incandescent lamps.

LOUISVILLE, KY.—The Board of Park Commissioners, it is reported, contemplates abolishing the use of gasoline lamps in Shawnee Park, Shawnee Drive, Western Parkway and Southern Parkway and substituting electric lamps to be supplied by the Louisville Gas & El. Co.

UNIONTOWN, KY.—Plans, it is said, are being considered for improvements to the local electric-light plant.

INDIANAPOLIS, IND.—The Board of Park Commissioners has awarded a contract for lighting the parks, bridges and boulevard to the Merchants' Ht. & Lt. Co., of Indianapolis, for a period of ten years. The contract price, based on the initial instalment, is $24,206 per year. The contract provides for a minimum of 600 incandescent lamps of 100 cp and 143 incandescent lamps of 250 cp. At the expiration of the contract all of the equipment is to become the property of the city.

CANTON, ILL.—Within the next 30 days the Canton Gas & El. Co. expects to purchase two 90-ft., one 40-ft. and one 60-ft. steel tower for river crossing, three 200-kw, 13,000-volt transformers and three 100-kw, 13,000-volt transformers. The company has just completed the erection of a substation, equipped with 800 kw in transformers, three sets electrolytic arresters and three automatic 13,000-volt oil switches, with remote electric control. All of the above are to step up from 2200 volts, two-phase, to 13,000 volts, three-phase, to supply energy to the Illinois Central electric railway substation, suburban towns and several drainage districts along the Illinois River. E. H. Negley is secretary and manager.

GRANTSBURG, WIS.—The proposal to grant a franchise to the Grantsburg Lt. & Pwr. Co. to install and operate an electric light and power plant in Grantsburg will soon be submitted to the voters.

OSHKOSH, WIS.—The Board of Education has authorized Henry Auber to prepare plans for the new central plant to supply light, heat and power for the Central High School and annex and the Beach Manual Training Institute. D. Witzel is city clerk.

STILLWATER, MINN.—The City Council is considering the question of establishing a municipal electric-lighting plant in Stillwater. The contract with the Consumers' Pwr. Co. for street lighting expires April, 1915.

BLENCOE, IA.—The Blencoe El. Lt. Co., recently organized, has awarded the contract for the erection of a transmission line from Onawa to Blencoe to the Midwest Construction Co., of Onawa. The Blencoe company will purchase energy from the plant in Onawa and will also furnish electricity to parties along the line between the two towns. William Davis is president of the Blencoe company.

FARRAGUT, IA.—Arrangements are being made by the Farragut Lt. & Pwr. Co. for the installation of a 3-ton ice manufacturing plant.

IOWA FALLS, IA.—The Iowa River Lt. & Pwr. Co., of Eldora, is contemplating extending its transmission lines to Whitton and Conrad this winter to furnish electrical service in those towns.

MASON CITY, IA.—Application has been made to the City Council by H. F. True, of Ladysmith, Wis., for a franchise to erect a transmission line from Mason City to Nora Springs. Mr. True has been granted a franchise to supply electricity in Nora Springs.

SALEM, MO.—The Salem Lt. & Pwr. Co. expects to erect within the next few months a new smokestack (45 ft. high, 34 in. in diameter) to replace the present stock. C. A. Wallof is general manager.

RUSSELL, N. D.—The installation of an electric-lighting plant in Russell is reported to be under consideration.

HAYTI, S. D.—Local capitalists, it is reported, have been granted a franchise by the Town Board to install and operate an electric-lighting system in Hayti.

DILLER, NEB.—The local electric-light plant has been closed down and plans are being considered for securing electricity for lighting the town from the plant in Fairbury.

GRAND ISLAND, NEB.—Within the next ten months the Grand Island El. Co. expects to construct a diverting dam and power house for generating apparatus of approximately 2500 kw; also to purchase a 750-kw steam-driven generating unit and a 2500-kw hydraulically driven generating unit and material for approximately 100 miles of transmission line. T. H. Fritts is general manager.

NORFOLK, NEB.—At an election held recently the proposal to authorize the City Council to enter into a contract with the Nebraska Gas & El. Co., of Norfolk, for lighting the streets of the city for a period of ten years was carried. The new contract provides for the erection of 400-cp lamps in the business section and the bracket system carrying 60-cp lamps in the residence district. Work will begin on the installation of the system at once.

FORT LEAVENWORTH, KAN.—Bids will be received by the constructing quartermaster, Fort Leavenworth, Kan., until Jan. 11 for construction of library building, including electric wiring, plumbing and heating.

LARNED, KAN.—Preparations are being made for the installation of a municipal electric-light plant in Larned. The equipment will include two motor-driven turbine pumps, one 125-kw and one 150-kw electric generating unit (directly connected) and an electric distributing system complete, bids for which will be received Jan. 18, 1915. Worley & Black, Reliance Building, Kansas City, Mo., are engineers.

Southern States

KINSTON, N. C.—Bids will be received at the office of the supervising architect, Washington, D. C., until Jan. 11 for the construction, including mechanical equipment, lighting fixtures and approaches, of the United States post office in Kinston, N. C. Drawings and specifications may be obtained at the above office or from the custodian of site at Kinston, N. C.

WADLEY, GA.—At an election to be held Dec. 21 the proposal to issue $6,400 in bonds for the installation of a municipal electric-light plant will be submitted to the voters.

PLANT CITY, FLA.—The Plant City Ice & Pwr. Co., it is reported, is contemplating increasing the output of its electric plant.

SAFETY HARBOR, FLA.—The County Commissioners have granted S. E. Talmadge and C. O. Lohmeyer a franchise to construct and operate an electric-light plant.

CHATTANOOGA, TENN.—The Chattanooga Enameling & Stamping Co. is planning to build a plant to manufacture enameled sheet steel and iron products, at a cost of about $100,000. The factory will be equipped with electrically operated machinery. Plans are being prepared by W. H. Sears, of Chattanooga. William Lipphardt, of Wheeling, W. Va., is president of the company.

McMINNVILLE, TENN.—The Council is contemplating the development of water-power on Collins River, about 3½ miles from the city, to provide power to operate the water-works system. The present steam plant is to be held for use in emergencies. Claude W. Pearsall is superintendent of the water and light plant.

HUNTSVILLE, ARK.—Plans are being considered, it is reported, by Frank Barr, of Fayetteville, for the construction of an electric-light plant. Energy for operating the system will be obtained from the plant of the Huntsville Milling Co.

PINE BLUFF, ARK.—The city of Pine Bluff is contemplating the purchase of the local electric-light plant and water-works. If the plants are taken over improvements will be made.

FREEPORT, TEX.—The Freeport Lt., Ice & Wtr. Co., recently incorporated, is reported to be contemplating the installation of an ornamental lighting system on Park Avenue, Second and Broad Streets in Freeport.

SAN ANGELO, TEX.—Plans, it is reported, are being considered by the San Angelo Wtr., Lt. & Pwr. Co. for the installation of a 3,000,000-gal. electrically operated pump in the water-works pumping station, at a cost of about $5,000.

VICTORIA, TEX.—The Texas Southern El. Co., which owns plants at Victoria, Cuero, Beeville, Bishop and Robstown, will soon begin work on the erection of a transmission line from Victoria to Cuero.

Pacific States

MONTESANO, WASH.—Plans have been prepared, it is reported, by the Northwest El. & Wtr. Wks., of Montesano, for the construction of a new steam-driven power plant in this city. The proposed plant will be situated on the water front and will burn either wood or oil. The storage basin at Sylvia Lake will be enlarged. The feed lines throughout the city will be rebuilt; in the business district the present lines will be replaced with copper wires. Work on the improvements will begin soon after the first of the year.

SEATTLE, WASH.—Bonds to the amount of $400,000 have been sold, the proceeds to be used for the construction of a steam power plant on Lake Union.

SEATTLE, WASH.—The installation of an additional generating unit at the Cedar Falls power plant, to cost about $500,000, has been recommended by J. D. Ross, chief engineer of the municipal electric plant. The plans provide for a third water main from the new masonry dam and power plant at Cedar Falls and for a new building and equipment to increase the output of the Cedar Falls system by 10,000 kw.

SPOKANE, WASH.—Plans are being considered by the Idaho Pwr. & Concentrating

Co. for the installation of a 600-hp electric generating unit at its plant, 10 miles from Sandpoint and 3 miles from Hope, on the Northern Pacific Railroad. The company expects to develop its water-power facilities and equipment to concentrate ores from this region.

TACOMA, WASH.—The City Council has authorized the city clerk to call for bids for furnishing and installing new luminous-arc lamps in the North End district of the city. The Council is also considering the question of removing all poles and wires on Union Avenue, South Tacoma, from Fifty-second Street to Fifty-eighth Street and installing luminous-arc lamps.

VANCOUVER, WASH.—Notice has recently been filed with the auditor of Clarke County by J. H. Cunningham of an appropriation of 500 cu. ft. per second of water of the east fork of the Lewis River. The water is to be used for hydraulic and electric power for municipal lighting, manufacturing and commercial purposes.

BISHOP, CAL.—The Nevada-California Pwr. Co. has applied to the State Railroad Commission for authority to execute an "open-ended" mortgage on all its properties to secure an issue of first and refunding 6 per cent 50-year bonds. Of the proceeds it is proposed to use the proceeds of the sale to refund outstanding bonds aggregating $2,663,000, constructing a new hydroelectric station at Bishop's Creek and for other improvements and additions. The present valuation of the properties is placed at $6,229,989. The company asks permission to issue bonds aggregating 85 per cent of the appraised value of the properties.

RIVERSIDE, CAL.—The Southern Sierras Pwr. Co., of Riverside, has awarded contract for erection of 24 miles of 33,000-volt, three-phase transmission line (wooden pole) from near Inyokern to Trona, Cal., at Searles Lake or Boxox Lake, to supply electricity to the American Trona Corpn., to be used in connection with the manufacture of potash, etc. The equipment will consist of three 75-kva, 33,000 2200-volt Fort Wayne transformers (at Trona), 35-ft., 7-in.-top. poles, open-tank-treated butts (20 per mile), insulators (Locke No. 319 and Ohio Brass Co. No. 9416), No. 6 solid copper wire, electrolytic, 33,000-volt, outdoor-type General Electric lightning arresters. M. A. Stampher, 1016½ West Forty-second Street, Los Angeles, Cal., has the contract. C. O. Poole, chief engineer of the Southern Sierras Pwr. Co., Riverside, has charge of the work.

SAN FRANCISCO, CAL.—Plans are being prepared by M. M. O'Shaughnessy, city engineer, for the construction of a municipal electric railway through Golden Gate Park into the Sunset district, to cost about $200,000.

SAN FRANCISCO, CAL.—The State Railroad Commission has authorized the Coast Valleys Gas & El. Co., of San Francisco, to issue $100,000 in bonds, of which the proceeds of $69,392 will be used to pay outstanding indebtedness and the remainder for additions and improvements.

SAN FRANCISCO, CAL.—The Board of Public Works has awarded the contract for constructing and installing the underground steam distributing system for the Civic Center buildings to the Willman-Lyman Co., at $23,964. The contract for furnishing equipment for the power house has been awarded to the Davis Rodger Co., for $11,950. T. W. McClenahan was awarded the contract for the construction of the civic center power house, at $10,800. The plant will be located at the corner of Larkin and McAllister Streets.

LEHI, UTAH.—Mayor W. F. Gurney and Councilmen W. S. Evens and William Wing have filed notice of appropriation of power site in the American Fork Canyon at the mouth of Deer Creek, where, it is estimated, 1500 hp could be developed. The filings call for two pipe lines, one from the main canyon and the other from Deer Creek, to be 18,000 ft. and 5000 ft. long, respectively, which will carry the water into a large reservoir, to be built on Silver Lake flat, which will be connected with the power plant by a steel pipe line 7542 ft. long. The cost of the proposed plant is estimated at $150,000. The officials disclaim any intention of building the plant until after a bill has been passed by the Legislature giving cities of the third class greater bonding power.

PHOENIX, ARIZ.—The installation of an ornamental street-lighting system on North Central Avenue, to be owned by the city, is under consideration. For further information address the city engineer.

FLAXVILLE, MONT.—The Commercial Club is reported to be interested in a project to install an electric-light plant in Flaxville.

THOMPSON FALLS, MONT.—The Northwest Development Co., which is constructing a large hydroelectric power plant at Thompson Falls, it is reported, is preparing to enter the Cœur d'Alene (Idaho) mining district to supply electricity to operate the machinery in the mines. Work will soon begin on the erection of the proposed transmission lines.

PUEBLO, COL.—The City Commissioners are considering the question of compelling the electric companies to place their wires underground in the new Mineral Palace paving district.

RED CLIFF, COL.—The installation of an electric-lighting system in Red Cliff is reported to be under consideration by John Fleming, of Red Cliff, who will soon apply for a franchise.

GOLDFIELD, NEV.—The City Council has awarded the contract for lighting the streets of the city to the California-Oregon Pwr. Co., of San Francisco, for a period of ten years. The contract provides for the installation of 18 three-cluster lamps, 35 single lamps on wooden posts and 16 lamps on iron standards and one large three-lamp cluster at the bridge, to be installed and in operation within 30 days.

Canada

KINGSTON, ONT.—The City Council has granted the Gananoque El. Lt. & Wtr. Supply Co., of Gananoque, a franchise to erect transmission lines in Kingston for the purpose of supplying electricity to operate the flour mills of the Kingston Milling Co., at the foot of Brock Street, and also the flour mill at the foot of Gore Street.

SHAWINIGAN FALLS, QUE.—Plans have been prepared, it is reported, by the Shawinigan Wtr. & Pwr. Co. for the erection of a transmission line from its plant at Shawinigan Falls to the city of Quebec. Julian C. Smith, of Montreal, is general superintendent and chief engineer.

Miscellaneous

PANAMA—Bids will be received at the office of the general purchasing officer, the Panama Canal, Washington, D. C., until Dec. 28 for furnishing iron and bronze castings, wire cable, sheet copper, etc. Blanks and general information relating to this circular (No. 883) may be obtained at the above office or from the office of the assistant purchasing agents, 24 State Street, New York, N. Y.; 614 Whitney-Central Building, New Orleans, La., and 1086 North Point Street, San Francisco, Cal. Major F. C. Boggs is general purchasing officer.

MANILA, P. I.—The Manila Pwr. Co., a Connecticut corporation with a capital stock of $1,000,000, has been granted permission by the Philippine authorities to build and operate hydroelectric power plants, distribute electricity, acquire water rights and engage in other similar activities within the Philippine Archipelago.

New Incorporations

TAHOE, CAL.—The Tahoe El. & Wtr. Co. has been incorporated with a capital stock of $100,000 by Mellville Jeffry and others.

STITHTON, KY.—The Stithton Ltg. Co. has been incorporated with a capital stock of $3,000. The company, it is understood, will take over the local plant. C. H. Aubrey is president of the company and L. J. Metcalfe is secretary and treasurer.

WINNFIELD, LA.—The Johnson Ice & Lt. Co. has been incorporated with a capital stock of $9,000. The officers are: J. M. Johnson, president, and J. E. Johnson, secretary.

AUGUSTA, MAINE.—The Santo Domingo Wtr., Lt. & Pwr. Co. has filed articles of incorporation under the laws of the State of Maine. The company is capitalized at $1,000,000 and proposes to acquire, construct, operate, lease and sell aqueducts, water-works, pumping stations, etc. L. J. Coleman is president and R. S. Buzzell is treasurer, both of Augusta.

CAMDEN, N. J.—The Clayton El. Lt. Co. has been incorporated with a capital stock of $100,000 to operate electric-light plants. The incorporators are F. R. Hansell, J. A. MacPeak and I. C. Clow, of Camden.

COUDERSPORT, PA.—The Coudersport El. & Pub. Ser. Co. has filed articles of incorporation under the laws of the State of Delaware with a capital stock of $50,000. The company proposes to conduct a general garage business and to furnish electricity for lamps, heaters and motors. The incorporators are F. W. Kendig, T. J. Ryan and R. A. Olmstead, of Coudersport.

FREEPORT, TEX.—The Freeport Lt., Wtr. & Ice Co. has been incorporated with a capital stock of $5,000 by C. A. Jones, F. F. Hastings and W. T. Andrews.

EXMORE, VA.—The Exmore Lt. & Pwr. Co. has been chartered with a capital stock of $10,000. The officers are: John T. B. Hyslop, of Belle Haven, Va., president, and John W. Chandler, of Exmore, secretary and treasurer.

Weekly Record of Electrical Patents

UNITED STATES PATENTS ISSUED DEC. 8, 1914.

[Prepared by Robert Starr Allyn, 16 Exchange Place, New York, N .Y.]

1,119,800. ELECTRIC-CURRENT CONTROLLER; L. Bradley, Muskegon, Mich. App. filed May 28, 1909. Has a carbon-pile resistor.

1,119,832. SWITCHING SOCKET OR CONNECTOR; G. C. Knuff, Chicago, Ill. App. filed Dec. 12, 1913. Contacts of both plug and socket are axially disposed.

1,119,838. ELECTRICAL HEATING UNIT; F. Kuhn, Detroit, Mich. App. filed March 8, 1913. Coil threaded through perforations in asbestos board.

1,119,839. ELECTRIC TERMINAL BOX; F. Kuhn, Detroit, Mich. App. filed March 8, 1913. Can be used as a socket to receive a terminal plug connector.

1,119,840. ELECTRICAL FLUID HEATER; F. Kuhn, Detroit, Mich. App. filed Sept. 8, 1913. Particularly for use in connection with carburetors.

1,119,841. ELECTRICAL HEATER; F. Kuhn, Detroit, Mich. App. filed Jan. 10, 1914. Insulated support for resistor.

1,119,864. ELECTRIC CONNECTOR; E. J. Ovington, Brookline, and J. E. Herlihy, Cambridge, Mass. App. filed Sept. 11, 1912. Plug-and-socket type.

1,119,872. ELECTRODE HOLDER; H. J. Potts, Kansas City, Mo. App. filed Dec. 23, 1912. Holds different-sized electrodes.

1,119,887. TROLLEY-POLE RETRIEVER; T. B. Shanahan, Manlius, N. Y. App. filed Sept. 1, 1909. Automatically lowers pole when wheel leaves wire.

1,119,901. HOIST; A. C. Van De Velde, Chicago, Ill. App. filed Feb. 29, 1912. Has automatic brake and automatic limit stop.

1,119,913. ELECTRIC RAILWAY; G. Westinghouse (deceased), Pittsburgh, Pa. App. filed Aug. 17, 1904. Tunnel system with means to prevent short-circuiting upon derailment.

1,119,915. SERVICE-METER CIRCUIT FOR TELEPHONE EXCHANGE SYSTEMS; S. B. Williams, Brooklyn, N. Y. App. filed July 12, 1913. For manual, semi or full automatic systems.

1,119,923. SELECTIVE SWITCHING APPARATUS; A. M. Bullard (deceased), New York, N. Y. App. filed July 30, 1909. Selective operations accurately and speedily accomplished.

1,119,928. LAMP SOCKET; J. Darby, Summit, N. J. App. filed March 12, 1910. Pull socket.

1,119,951. RECTIFIER; V. M. Harris, Chicago, Ill. App. filed Aug. 24, 1912. Mechanical; compensates for current variations in the main line.

1,119,952. TRANSMITTER FOR WIRELESS COMMUNICATION; W. Harrison, New York, N. Y. App. filed Jan. 27, 1903. Uses a number of separate oscillators.

1,119,953. BLOCK SIGNAL SYSTEM; L. A. Hawkins, Schenectady, N. Y. App. filed Jan. 31, 1910. Tracks cross-bonded every block.

1,119,966. Electric Switch; C. J. Klein, Milwaukee, Wis. App. filed April 28, 1911. Push-button flush switch.

1,119,967. Adding Machine; H. Landsiedel, Poplar Bluff, Mo. App. filed April 29, 1912. Has automatic motor drive.

1,119,971. Circuit Interrupter; H. G. MacDonald, Pittsburgh, Pa. App. filed June 8, 1907. Manually operated device prevents unnecessary operation of overload circuit-breaker.

1,119,973. Lightning Conductor; L. L. Mast, West Milton, Ohio. App. filed Dec. 16, 1910. Special joint for sheathed conductors.

1,119,978. Trolley; W. E. Moore, Pittsburgh, Pa. App. filed Feb. 16, 1912. The spring is housed within the hollow lower end of the pole.

1,119,987. Motor Controller; G. R. Redley, Milwaukee, Wis. App. filed Oct. 2, 1911. Particular method of changing motor field windings from series to parallel.

1,119,988. Coil Support; L. Rapp, Pittsburgh, Pa. App. filed Oct. 23, 1912. Made of sheet metal.

1,120,003. Electric Heater; A. A. Warner, New Britain, Conn. App. filed Aug. 7, 1913. Portable, reflector type.

1,120,006. System of Electrical Distribution; J. L. Woodbridge, Philadelphia, Pa. App. filed Aug. 25, 1910. Embodies alternating-current circuit and storage battery.

1,120,018. Electric-Current-Controlling Device; L. Bradley, Milwaukee, Wis. App. filed Jan. 29, 1912. Has compressible resistance.

1,120,025. Start and Stop Signal for Railroad Cars; R. H. Cartmell, Detroit, Mich. App. filed Feb. 9, 1914. Motorman's starting indicator is set only when conductor of each car in the train has signified readiness.

1,120,031. Emergency Valve and Circuit-Breaker Trip; H. Cordell and J. G. Tawse, Chicago, Ill. App. filed March 8, 1911. For cutting off propulsion current and applying brakes.

1,120,040. Holding Device for Instruments; C. W. Dunham, Swissvale, Pa. App. filed Feb. 24, 1914. For holding the delicate contacts of a relay or the like during shipment.

1,120,049. Telephone Apparatus; O. M. Glunt, Rutherford, N. J., and C. G. Mueller, Elizabeth, N. J. App. filed Aug. 27, 1913. Transmitter for limousine telephone.

1,120,054. System for Signaling Through Space; W. Harrison, New York, N. Y. App. filed July 20, 1905. Plurality of separate aerials and plurality of separate transformers.

1,120,057. Diaphragm Horn; M. R. Hutchison, West Orange, N. J. App. filed Oct. 26, 1909. Motor-operated.

1,120,074. Distributing and Measuring System for Electricity; T. M. R. Meikleham, New York, N. Y. App. filed Jan. 13, 1910. Alternating current or direct current; for measuring the plant capacity required by each consumer during peak of load.

1,120,077. Battery Holder; G. L. Patterson, New York, N. Y. App. filed Aug. 21, 1912. Interconnected battery holding units, screw-cell type.

1,120,084. Annunciator; F. C. Ries, Macon, Ga. App. filed Oct. 8, 1913. Magnets with armatures which will vibrate for several minutes.

1,120,086. Arc Lamp; A. C. Roebuck, Chicago, Ill. App. filed Oct. 24, 1910. For optical projecting apparatus.

1,120,110. Incandescent Electric - Lamp Socket; A. Weber, Jr., Schenectady, N. Y. App. filed Jan. 16, 1909. Cap and shell lock with means for preventing turning of the socket body therein.

1,120,112. Timer and Distributer; W. D. C. Wright, Philadelphia, Pa. App. filed June 6, 1914. Make-and-break devices can never stop in contact.

1,120,140. Electrical System of Distribution; J. B. Entz, Cleveland, Ohio. App. filed Oct. 28, 1910. Storage battery in parallel with generator for regulating the fluctuations of a varying load.

1,120,148. Electrical System of Distribution; R. C. Hull, Philadelphia, Pa. App. filed July 28, 1911. Storage battery maintains supply of current in case of failure of usual source.

1,120,160. Hanger for Arc Lamps; C. E. Pope and R. S. Phillips, Cleveland, Ohio. App. filed Feb. 7, 1914. Provided with separable electrical connections for the lamp.

1,120,175. Process for Recovering Precious Metals; F. W. Wiswell, Oakland, Cal. App. filed Feb. 11, 1914. From sand, gravel, etc., by use of mercury and with or without the aid of electric current.

1,120,191. Apparatus for Electrolytic Production of Wire; W. E. Gibbs, Plainfield, N. J. App. filed April 4, 1912. Electrode position and drawing.

1,120,207. Selective Signaling System; O. T. Lademan, Milwaukee, Wis. App. filed April 30, 1912. Step-by-step variety; applied to a police system.

1,120,210. Locking Switch; J. Maibaum, New York, N. Y. App. filed July 11, 1913. Prevents separation of the switch blade or spreading of the switch contacts.

1,120,212. Protective Device for Electric Circuits; A. V. A. McHarg, New York, N. Y. App. filed Nov. 28, 1913. Switch protected by a fuse which is not in the circuit

1,120,214. Measuring the Quantity of Fluid Flowing Through Pipes; K. Metzdorff, Berlin-Tegel, Germany. App. filed May 28, 1914. By means of the pressure difference in an electric way.

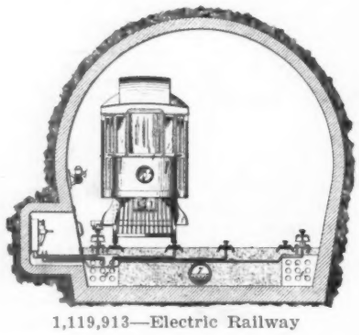
1,120,217. Electrical Measuring Instrument; F. W. Morris, Brooklyn, N. Y. App. filed Dec. 24, 1912. Current measured by the mutual reaction of two fields.

1,120,221. Electric Fuse; T. E. Murray, New York, N. Y. App. filed Feb. 10, 1913. Fuse carrier readily insertible in case and a thread looped about the fuse indicates its blowing.

1,120,222. Electrically Controlled Cut-Out; T. E. Murray and A. V. A. McHarg, New York, N. Y. App. filed July 11, 1913. Upon overload or failure device automatically withdraws the fuse plugs.

1,120,223. Fuse Box; T. E. Murray, New York, N. Y. App. filed March 11, 1914. Slidable fuse-carrying plug must be withdrawn to break circuit before fuse can be inserted.

1,120,224. Electric Bath Cabinet; T. E. Murray, New York, N. Y. App. filed March 11, 1914. Made up of plates flexibly hinged together.



1,119,913—Electric Railway

1,120,225. Electric Cut-Out; T. E. Murray, New York, N. Y. App. filed March 28, 1914. Pivoted switch levers carrying fuse plugs.

1,120,226. Electric Fuse; T. E. Murray, Jr., Brooklyn, N. Y. App. filed March 28, 1914. Has a localized blowing point inclosed gas-tight in insulating material.

1,120,241. Electric Time Mechanism; S. G. Rhodes, New York, N. Y. App. filed Oct. 17, 1912. Mercury contact carried by the pendulum.

1,120,259. Resistance Unit; H. J. Wiegand, Milwaukee, Wis. App. filed March 22, 1911. Resistance wire laced in convolutions on base and looped over peripheral projections on the base.

1,120,261. Translator for Printing-Telegraph Systems; J. E. Wright, New York, N. Y. App. filed Aug. 22, 1913. Special arrangement of circuits and contacts.

1,120,301. Distributer for Electrical Ignition Systems for Internal-Combustion Engines; E. Gassmann, Brooklyn, N. Y. App. filed Nov. 28, 1913. Made waterproof.

1,120,306. Magnetic Lift for Electrodes in Electric Oscillators; C. D. Herrold, San José, Cal. App. filed May 7, 1913. High-frequency oscillator with adjustable elements.

1,120,315. Magneto-Operating Mechanism; L. F. Kristufek, Chicago, Ill. App. filed Dec. 1, 1911. Produces monetary acceleration of magneto when engine is operating slowly.

1,120,354. Primary Cell; P. Young, Detroit, Mich. App. filed Feb. 10, 1914. Of small size and capable of being recharged.

1,120,356. Perforated-Tape Reproducer; C. G. Ashley, Toronto, Ontario, Canada. App. filed Feb. 13, 1913. Transmitting tape can be reproduced either locally or at a distance.

1,120,375. Clutch and Controller for Printing Presses; H. H. Cutler, Milwaukee, Wis. App. filed April 18, 1904. Utilizes effects of induction and of frictional contact.

1,120,376. Alternating-Current Motor Controller; W. E. Date, Westfield, N. J. App. filed Nov. 2, 1908. Resistance in the three phases of the secondary is balanced when the motor circuit is first closed.

1,120,382. Switch; B. Haskins, Milwaukee, Wis. App. filed May 15, 1911. Double-throw oil switch with new form of contact.

1,120,414. Automatic Reciprocating Electromagnetic Motor; F. E. Schoolfield, Covington, and J. C. Cowen, Bellevue, Ky. App. filed July 7, 1911. For rock drills and the like.

1,120,459. Condition Indicating Mechanism for Signaling Systems; H. W. Doughty, Binghamton, N. Y. App. filed Sept. 19, 1912. Warns central station when springs of boxes need rewinding, etc.

1,120,472. Electrical Junction Box; E. H. Freeman, Trenton, N. J. App. filed April 11, 1912. Has interchangeable sides to meet different requirements.

1,120,492. Electric Lamp; S. M. Hino, Rock Springs, Wyo. App. filed Nov. 12, 1912. Multi-filament with switches for cutting in and out.

1,120,493. X-Ray Tube; I. S. Hirsch, New York, N. Y. App. filed May 15, 1913. Has double walls to contain a cooling and ray-filtering medium.

1,120,499. Electric Signaling Device; A. S. Huckins, Philadelphia, Pa. App. filed Jan. 14, 1914. Doorbell which automatically indicates when it is inoperative.

1,120,517. Device for Protecting Telegraph and Like Lines Against Inductive Action from Neighboring Circuits; O. Moll and P. Kuschewitz, County of Kent, England. App. filed May 22, 1913. Transformer with a capacity and a variable resistance.

1,120,554. Connector for Battery Terminals and Other Electrical Conductors; A. H. Snyder, Lancaster, N. Y. App. filed Aug. 13, 1913. Contact pieces inclosed and protected from acid or acid fumes.

1,120,586. Circuit Closer for Electric Railways; A. W. Barnhart, Ellenboro, West Va. App. filed May 20, 1914. For railways of surface contact type

1,120,589. Vehicle Safety Signal Light; F. O. Bean, Somersworth, N. H. App. filed May 9, 1913. Tail-lights on opposite sides at rear controlled by turning of steering wheel.

1,120,605. Telephone System; W. W. Dean, Elyria, Ohio. App. filed March 12, 1908. Operator cannot connect ringing generator in circuit with a busy line.

1,120,606. Party-Line Telephone System; W. W. Dean, Chicago, Ill. App. filed March 12, 1908. Ringing keys connected with a strand of the cord circuit through normal contacts of the supervisory relay.

1,120,613. Burglar-Alarm Window Lock; L. L. Grove, St. Louis, Mo. App. filed May 27, 1914. Sounds alarm when unlatched.

1,120,615. Alternating-Current Motor; V. M. Harris, Chicago, Ill. App. filed May 25, 1911. Synchronous type.

1,120,616. Motor Starter; V. M. Harris, Chicago, Ill. App. filed Aug. 24, 1912. For synchronous motors.

1,120,619. Diaphragm Horn; M. R. Hutchison, West Orange, N. J. App. filed Oct. 26, 1909. Motor is disposed at an acute angle to the diaphragm.

1,120,623. Supervisory Alarm System; J. G. Nolen, New York, N. Y. App. filed July 23, 1909. For electro-pneumatic systems.

1,120,637. Apparatus for Recovering Precious Metals; F. A. Wiswell, Oakland, Cal. App. filed Feb. 11, 1914. Has a toothed shell and a toothed drum rotating within the same.

1,120,639. Car Truck; W. S. Adams, Philadelphia, Pa. App. filed March 30, 1914. Has arched semi-elliptic springs surmounted by coiled springs.

1,120,648. Electric-Trolley-Line Construction; L. S. Boggs, New Rochelle, N. Y. App. filed April 12, 1912. Trolley "deflectors" for overhead high-speed systems.